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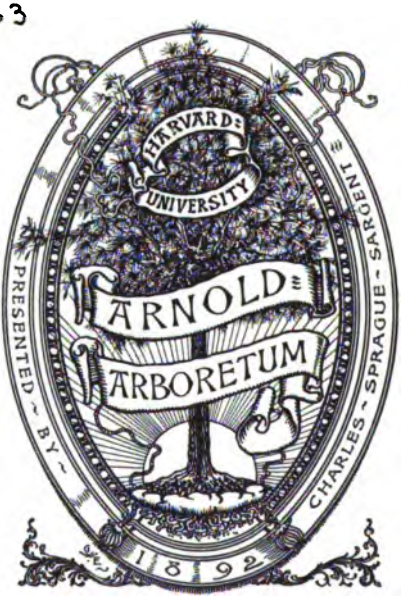
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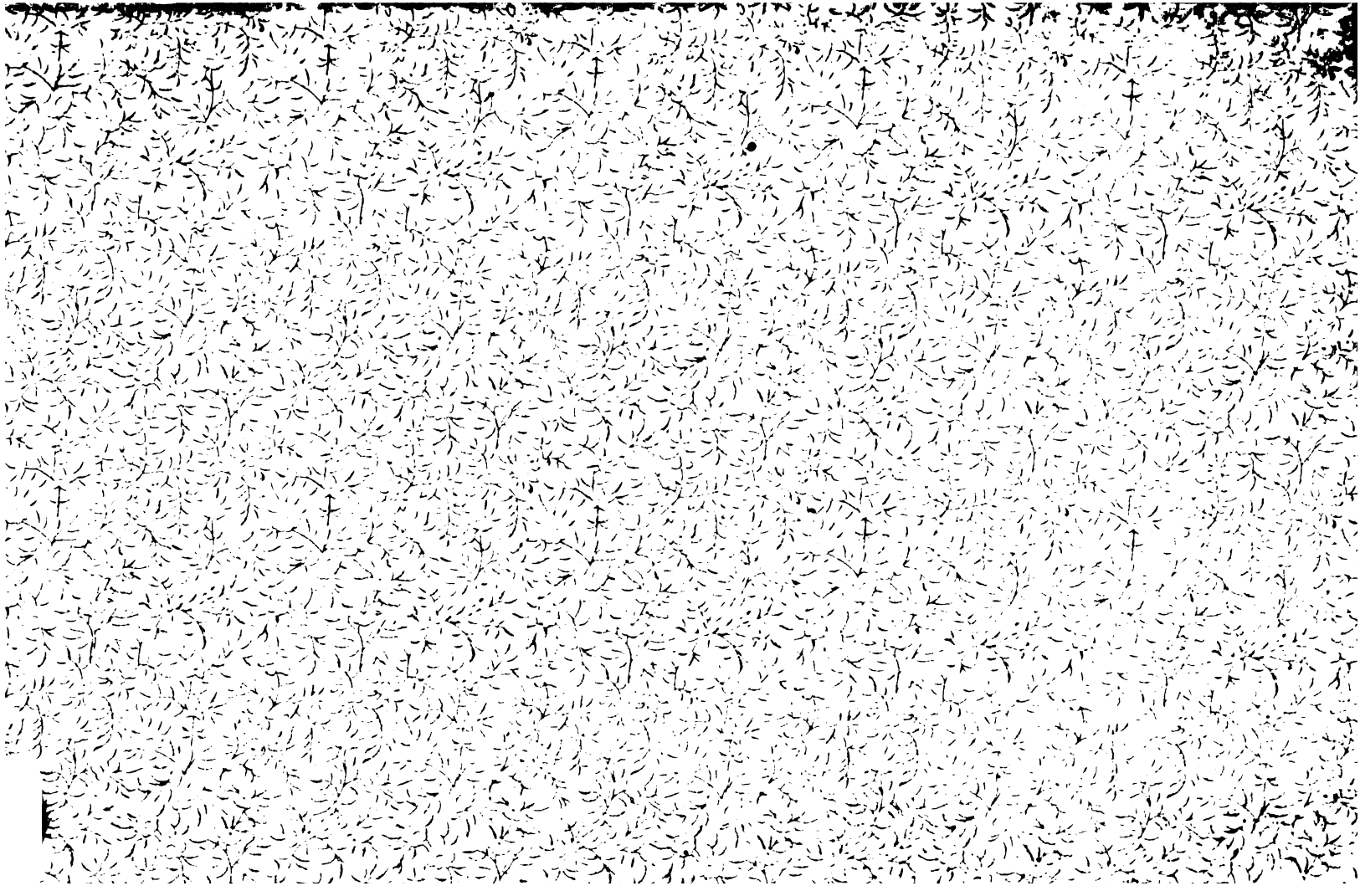

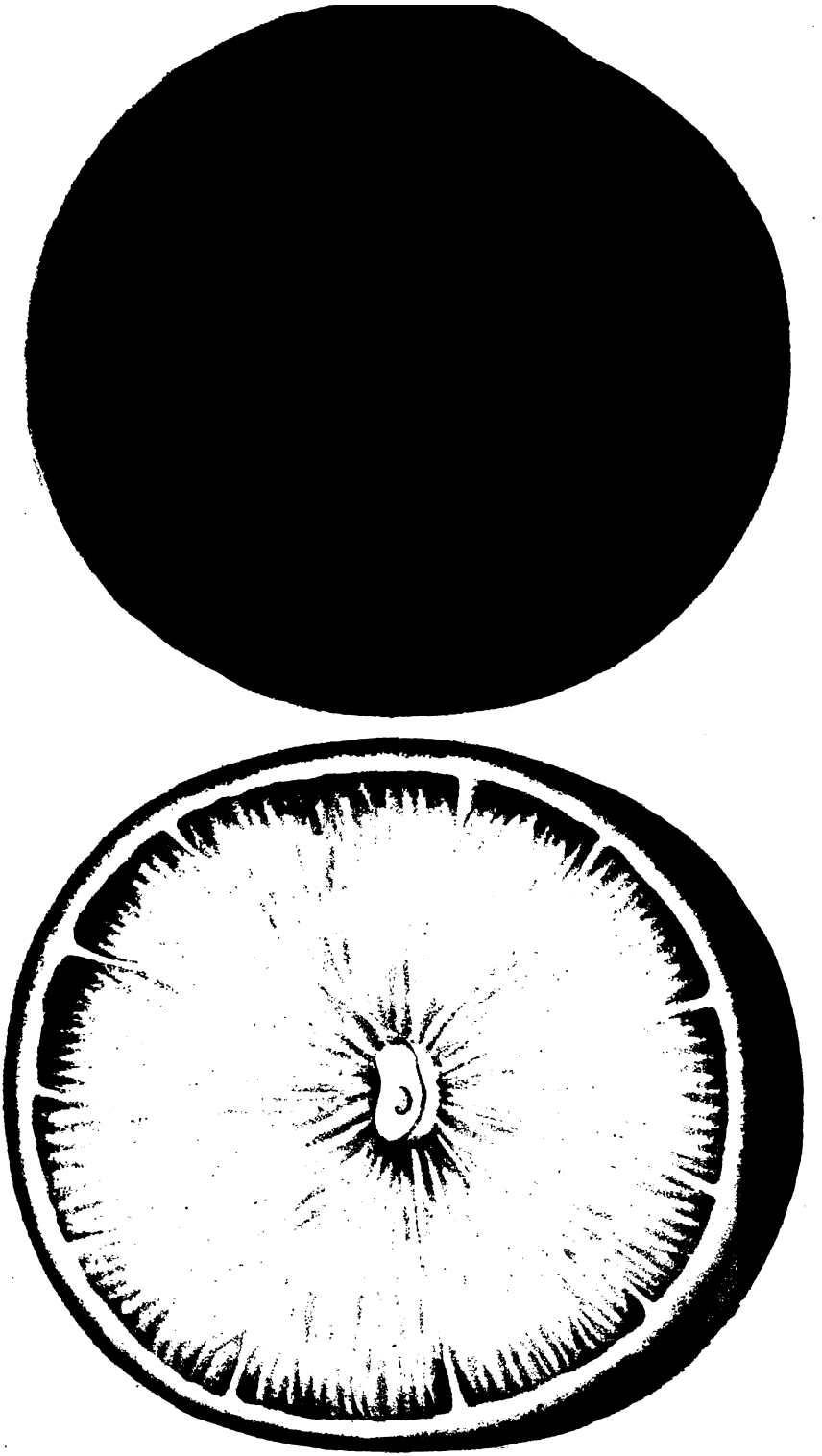

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THE

CALIFORNIA FRUITS

AND

HOW TO GROW THEM.

A MANUAL OF METHODS WHICH HAVE YIELDED GREATEST SUCCESS; WITH LISTS OF VARIETIES BEST ADAPTED TO THE DIFFERENT DISTRICTS OF THE STATE

BY EDWARD J. WICKSON, A. M.

Associate Professor of Agriculture, Horticulture and Entomology in the University of California; Horticultural Editor, Pacific Rural Press, of San Francisco; Secretary, California State Horticultural Society; President, California State Floral Society; President, San Francisco Microscopical Society, etc.

"The branch here bends beneath the weighty pear
And verdant olives flourish round the year.
The balmy spirit of the western gale
Eternal breaths on fruits untaught to fail;
Each dropping pear a following pear supplies;
On apples, apples, figs on figs arise;
The same mild season gives the blooms to blow,
The buds to harden, and the fruits to grow."
—*Pope's Hom. Odys. Bk. VII.*

SECOND EDITION, REVISED AND ENLARGED.

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TO

MY ESTEEMED ASSOCIATES

OF THE

CALIFORNIA STATE HORTICULTURAL SOCIETY

THIS WORK IS

RESPECTFULLY INSCRIBED:

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IS, IN THE MAIN,

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OR THEREBY SUGGESTED,

NOTE TO SECOND EDITION.

THE kind reception and generous patronage accorded to this work has necessitated a re-issue of it much sooner than was anticipated. Sufficient time has not elapsed to demonstrate the advisability of any radical change in its matter or manner, consequently the second edition maintains the leading features of the first edition. There has been, however, a thorough revision of the text, the incorporation of points of practice which have come to the knowledge of the writer during the last two years, the extension of statistical tables to the beginning of the year 1891, and the addition of new text and engravings which fill about twenty-five pages and enlarge the work to that amount.

This book is intended to improve with age and to keep fully abreast of the progress of our fruit-growing industry by thorough revision of its successive editions. Consequently the writer desires to impress upon all readers his earnest wish for the latest results of their experience and observation, as invited in the preface to the first edition, which will be appended.

The gratifying success of this work, which necessitates this speedy appearance of a new edition, prompts the author and publishers to extend to all whose kind commendation has largely achieved the popularity of the book, most sincere thanks.

EDWARD J. WICKSON.

Berkeley, California, August, 1891.

PREFACE TO FIRST EDITION.

THE wonderful growth of the fruit interest of California and the disposition to engage in fruit growing, both among Californians who have hitherto followed other pursuits, and among the many intelligent and enterprising people who are now choosing California as a home and a field for effort and investment, have made a demand for a manual of successful practices under the peculiar conditions which prevail here.

The excellent works of Eastern and foreign authors are of but indirect value, because our soils and climates render their advice and suggestions for practice in many respects inapplicable, and the varieties of fruit which they commend are often ill suited to our conditions.

It is evident that horticulture in California must create a literature of its own, and it is fair to expect that in the future, as the greatness of the interest is more nearly attained, there will be literary labors achieved which will be commensurate with the charm and importance of the theme.

Hitherto the literature of our fruit interest has consisted in the valuable reports of our State institutions, in monographs on several semi-tropical fruits, and in contributions to the columns of periodical publications, and, though these records of experience have been of much value, they are not widely available to the general reader. It is high time that an effort should be made to give the results of this experience a permanent form, convenient for reference. This is the object held in view by the writer of this work. He arrogates to himself no originality beyond such as may be exhibited in its style and method of presenting facts, to obtain which he has, for a number of years, occupied exceptionally favorable positions. In the work he is actuated by a sincere devotion to horticultural arts and enjoyment of them, and an earnest desire to assist the thousands who are embarking, or desirous to embark, in California fruit growing, but who have little or no practical acquaintance with its methods or materials.

The author desires to return his sincere thanks to the hundreds of friends whose experience has been so freely related in answer to his requests for practical information. The aim has been throughout the work to fully acknowledge the sources whence aid has been received, both because of honesty and fairness, and that this work might also serve as an index to the horticultural experience and literature of the State, and to indicate many by whose observation, thought, and enterprise, practical methods have been successfully devised to meet the requirements of a new country.

To the publishers special acknowledgment is due for the generous provision made for full illustration and embellishment of the work. The full-page plates of California seedling fruits are made by the Dewey Engraving Co., by a photographic process, directly from the fruit itself, thus securing striking fidelity to nature, which must commend itself to all.

Notwithstanding the careful effort which has been put forth, this work will be found in some respects incorrect and incomplete. The writer will be grateful to any reader who will point out inaccuracies or furnish information which will supply any deficiency. The State is great, its conditions are diverse, and it is only by the fullest sympathy and helpfulness among all observers and practical workers that truth and accuracy can be attained. To this end correspondence with fruit growers is earnestly solicited.

EDWARD J. WICKSON.

Berkeley, Alameda County, California, June, 1889.

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CALIFORNIA FRUITS.

PART FIRST: GENERAL.

CHAPTER I.

THE CLIMATE OF CALIFORNIA AND ITS LOCAL MODIFICATIONS.

IT has become somewhat trite to speak of climate as one of the resources of California, but the allusions are made sometimes in a spirit of raillery, or, if seriously, with only a partial appreciation of the real value of this accredited asset of the State. It is not alone its significance as an item in real-estate valuation, nor its importance as a remedial agent, nor its measure as one of the delights of living, nor all these combined, which gives the most tangible proof of the value of the climate of California. This proof can be found rather in a proper estimate of its value as an actual factor in production. It would be foreign to this work to attempt an adequate estimate of this kind, for it would lead far beyond the limits of the fruit industry. It would include the elements of early maturity and unchecked growth in all animals the flesh or products of which are used for food; the precocity, speed, and endurance of our horses; the fineness and weight of our product of wool and mohair, and the growth and yield of all field and garden products. In every agricultural effort, the climate of California stands beside the producer as a constant and enduring friend and co-worker. Thus a mysterious and uncontrollable force, which most agriculturists fear, because it has long been written that "no man can farm against climate," becomes in California an ally of the producer who is intelligent enough to choose his location in accordance with a few easily-ascertained conditions.

So many excellent essays and reports have been written upon the climate of California and the Pacific Coast that it will not be desirable or necessary to attempt an elaborate compilation of facts concerning it.* For the benefit of the newcomer or the distant reader it may be desirable to offer a few general statements to indicate some of the chief climatic conditions under which the practices described in other chapters are carried on.

The climate of the Pacific Coast is described by the meteorologist as "insular or moderate," as contrasted with the "continental or excessive" climate of the Atlantic Coast. The west coast of Europe is also insular in its climate. The northern limit of an annual mean temperature of 50° Fahr. is about 51° 30′ of north latitude on both western coasts of Europe and America. But though there is this similarity in mean annual temperature, there is a decided advantage pertaining to our climate over that of West Europe in that our range of temperature is less; that is, extremes of heat and cold are nearer together, and changes are therefore much less excessive. This characteristic of our local climates is due in the main to two great agencies, one active, bringing heat; the other passive, shielding us from Arctic influences.

First: The great Japanese current is composed of two streams of heated water from the Indian Ocean, which join off the coast of Japan, and, proceeding northerly, divide again. The main body, coming toward the west coast of America, turns easterly and southerly, flowing along the coast of Oregon and California. These waters produce such an effect on the climate, owing to the warmth they bring with them, that, as Von Baer tells us, "on the south side of Alaska you meet with hummingbirds, while the northern shores, which are washed by the cold current coming out of Behring Straits, are visited by walruses." This stream brings heat to our coast, as the Gulf Stream does to that of Europe, but, owing to the great distance across the Pacific, it does not bring the violent storms and calorific and electric phenomena which sometimes accompany the Gulf Stream across the narrower Atlantic. In its long course the Japanese current spends its meteorological fury on the east coast of Asia and brings us only the welcome trade-winds during the summer months, which are esteemed as mitigative of summer heat, though they may be counted rather harsh at certain points immediately on the coast, and at these points may prevent the ripening of certain fruits, as will be shown.

*I would note especially for their excellence and availability the annnal reports by Sergeant J. A. Barwick in the transactions of the California State Agricultural Society, 1886–90.

This gentle ocean current finds but slight counter current in the upper Pacific, because the Straits of Behring are too narrow and shallow to allow egress to any considerable amount of Arctic waters, so that the Pacific is not vexed with a frigid flow, carrying icebergs to low latitudes, as is the case in the waters of the Atlantic. For three hundred days in the year the air currents from this vast body of warm, placid waters flow over California, moderating summer heat and winter cold, and, impinging on the western slope of the Sierra Nevada, give to the foot-hills, up to a certain elevation, a valley climate and a valley range of products, as will be noted later.

Second: Another agency contributing to the mild climate of the Pacific Coast is passive and consists in the mountain barriers upon our northern and eastern boundaries. Redding says it was Guyot who first called attention to the fact that the Sierra Nevada and the Cascade Mountains reach the coast of Alaska and bend like a great arm around its western and southern shore, thus shutting off or deflecting the polar winds that otherwise would flow down over Oregon and California.

CHIEF TOPOGRAPHICAL AND CLIMATIC DIVISIONS OF CALIFORNIA.

California is usually divided into three main areas and climates, each distinct in typical conditions and yet separated by regions, more or less wide, in which these conditions merge and influence each other. Dr. Robertson says:*

> Isothermal lines which normally run east and west are, as they near the Pacific, deflected north and south, and define three distinct climatic belts. These may be named coast, valley, and mountain; and while they resemble each other in having only two seasons, they are dissimilar in other respects. These differences depend upon the topography of the country, and are of degree rather than of kind; altitude, distance from the ocean, and situation with reference to mountain chains, giving to each region its characteristic climate.

How similar are the conditions which prevail in these belts may be learned from the data shown in the following table, which includes points separated by nearly the whole length of the State, the difference in latitude of the extreme north and south points being seven or eight degrees. Thus, through a north and south distance great as that which separates the States of Georgia and New York, similar climatic conditions prevail in California. In the following table the averages are deduced from observations by the United States Signal Service observers for a long series of years:—

*Report of State Agricultural Society, 1886, p. 322.

SEASONAL AND EXTREME TEMPERATURE AND RAINFALL AT VARIOUS STATIONS IN THE CLIMATIC BELTS OF CALIFORNIA.

STATION.	COUNTY.	Elevation, Feet.	Average Winter Temperature.	Average Spring Temperature.	Average Summer Temperature.	Average Fall Temperature.	Average Annual Temperature.	Highest Temperature.	Lowest Temperature, Degrees above Zero.	Average Seasonal Rainfall, Inches.
Coast.										
San Diego.....	San Diego....	40	54	58	66	62	60	101	32	11 01
Los Angeles....	Los Angeles..	334	54	58	68	63	60	112	28	17 64
Santa Barbara...	Santa Barbara	30	54	59	68	63	61	102	31	16 92
Santa Cruz.....	Santa Cruz...	25	52	58	62	59	58	98	30	25 88
San Jose.....	Santa Clara...	94	49	56	66	59	58	108	24	12 95
San Francisco..	San Francisco	60	51	54	58	58	55	95	28	24 25
Napa.....	Napa.....	20	49	59	69	59	59	104	18	23 36
Hydesville.....	Humboldt....	....	45	52	59	55	53	84	24	38 49
Valley.										
Indio.....	San Diego...	12	55	73	92	75	73	121	19	2 32
Riverside.....	San Bernardino	....	50	64	73	66	63	105	25	8 16
Fresno.....	Fresno.....	295	50	65	84	67	66	115	18	9 57
Sacramento....	Sacramento..	35	48	59	71	61	60	106	19	19 80
Marysville.....	Yuba.....	69	50	63	78	65	64	108	18	16 60
Oroville.....	Butte.....	171	52	64	79	64	65	102	20	22 11
Red Bluff.....	Tehama.....	307	47	60	80	63	62	110	16	27 46
Foot-hill.										
Auburn.....	Placer.....	1363	46	56	74	62	60	106	13	33 15
Colfax.....	Placer.....	2421	46	56	76	60	59	106	16	45 16
Georgetown....	El Dorado....	2750	50	59	85	67	64	102	11	60 04
Keene.....	Kern.....	2705	44	55	73	59	58	102	9	13 28
Mountain.										
Berryvale.....	Siskiyou	3462	35	41	..	48	..	102	9	28 76
Alta.....	Placer.....	3612	42	53	72	58	56	106	7	43 76
Fort Bidwell...	Modoc.....	4647	32	47	69	51	50	100	19*	20 07
Cisco.....	Placer.....	5939	32	39	61	47	45	96	9*	57 55
Summit.....	Placer.....	7017	29	36	56	43	41	95	10*	47 95
Tehachepi.....	Kern.....	3964	39	52	72	55	54	102	0	10 04
King's Station..	San Bernardino	4300	41	50	65	55	53	99	12	22 49

*Below zero.

LOCATIONS FOR THE GROWTH OF DIFFERENT FRUITS.

It is intended to describe as definitely as possible the locations suitable for the growth of different fruits in the special chapters given to those fruits, but there are a few general conditions which should be outlined.

In discussing the choice of location for an orchard it is not intended to speak geographically. A few years ago men could have been found willing to definitely divide the State according to its adaptation for certain specified fruits, but most of them would decline to do it now. As has already been intimated,

latitude, which is a prime factor in geography, is of exceedingly small account as an indication of horticultural adaptations in California. The fact becomes strikingly apparent when it is known that the apple and the orange, fruit kings whose kingdoms lie at opposite borders of the temperate zone, so far distant that one may be called semi-frigid and the other semi-tropical, have in California utter disregard for the parallels of latitude, which set metes and bounds upon them in other lands, and flourish side by side, in suitable localities, from San Diego to Shasta. Impressive as this truth may be, it is not so startling as another fact, viz.: that fruits ripen earlier at the North than at the South—a complete reversal of the tenets of the geographer.

It is apparent then that the selection of locations for orchards must be made with a knowledge of special conditions governing the distribution of equal temperatures and other natural agencies contributing to the development of fruit. This distribution, as has been intimated, is not by straight lines, as in parallels of latitude, but by curves, which proceed in various directions, governed chiefly by topography. These are curves of temperature, of rainfall, of elevation, of soil formation and deposit. Geography retires from authority; topography and climatography govern.

Let these ruling conditions be reviewed, then, briefly: First, as to general areas; second, with reference to special situations and locations.

COAST CLIMATE.

The chief characteristics of the coast climate are equable temperature, increasing southward; summers cool and winters warm as compared with the interior; abundant rainfall, decreasing considerably southward; a somewhat humid atmosphere, as compared with the interior; frequent fogs or overcast skies; prevailing westerly winds.

The extension of coast influences toward the interior is governed by local topography. Coast valleys open to coast winds are cooler and moister and demand hardier fruits than valleys sheltered by intervening ranges. Gaps and passes in the ranges are subject to winds of considerable force and low temperature, and are not generally favorable for fruit; on the other hand, situations sheltered on the north and west favor growth of fruit even though quite near the coast. Sometimes a distance of a few miles, sometimes a wind-break of natural forest or of planted trees, so modifies coast influences that fruits do well. Elevation on the sides of coast valleys secures similar results.

For example, the floor of the Pajaro Valley is well suited for apples, late pears, cherries, plums, prunes, and berries (except gooseberries), while on adjacent hill-sides peaches do well.

In Southern California coast-winds are warmer than in the upper half of the State, but coast influences intrude farther, as a rule, because the hills near the coast in Southern California are low; the high ranges, answering to the Coast Range of the upper part of the State, trending far into the interior. On the coast side of these ranges fruits ripen later than in sheltered interior points in the upper part of the State, but eastward of them, where soil and moisture favor, or irrigation is practiced, extra early locations have been found.

Some of the horticultural effects of the conditions prevailing on the coast may be described as follows:—

LATE RIPENING OF FRUITS.—The late ripening of fruits in most parts of Southern California has just been mentioned. Intrusion of coast influences has the same effect at the North. Directly on the coast, at Pescadero, San Mateo County, for example, fruits ripen about a month later than in Santa Clara Valley, which is just across the Coast Range. Napa Valley, though about forty miles inland and sheltered by ranges of hills, still is sufficiently affected by coast influences to mature fruits considerably later than Vaca Valley, ten miles farther east, beyond a higher range, which completely bars out these influences. In Ventura County, in a cañon sixteen miles from the ocean, and at an elevation of sixteen hundred feet, fruits ripen three weeks earlier than on the coast or in the valley opening thereon.

FAILURE OF CERTAIN FRUITS.—Though killing frosts are few directly on the coast, the deficiency in summer heat and sunshine renders some fruits unsatisfactory. This is especially the case in the upper coast region. Grapes and figs ripen imperfectly, while but a short distance back from the coast, in sheltered situations, they do well. Elevation sometimes produces corresponding effects. The complete reversal of coast conditions by local topography is seen in the Happy Camp region, on the east side of Del Norte County, the extreme north coast county of the State. Happy Camp is in a warm belt, at an elevation where peaches, apricots, and nectarines do well if irrigated. The apricot at that latitude in ordinary situations is a failure, as it also is for a certain distance farther south along the coast.

PESTS AND DISEASES.—Certain blights are more prevalent under coast conditions. The scab blight of the apple, the curl leaf of the peach, and some other blights, are prevalent on the cost and in coast valleys, on the river bottoms in the inte-

rior, and on the mountains, and less serious, or wholly absent, in the hot interior valleys. Some insects prefer the coast, notably the black scale, which, with the black smut which attends it, has long been a grievous pest of growers of olives and citrus fruits, and has recently become prevalent on deciduous fruit trees in some regions. Directly under coast influences, moss and lichens gather quickly and should be removed. Spraying with alkaline washes not only kills insects but cleans the bark from parasitic vegetable growth.

Although fruit trees on the coast are not so subject to sunburn as in the interior, there is especial value in low heading to withstand winds; there should also be plenty of room given the trees, that sunshine, which is none too abundant, may have free access to warm the ground all around the tree.

VALLEY CLIMATE.

The characteristics of the interior valley climate are higher summer and lower winter temperatures than on the coast, the range of temperature being very nearly the same both north and south; rainfall abundant in the north and decreasing rapidly southward, so that as a rule the interior valleys in the south half of the State require irrigation; very dry air and almost constant sunshine, freedom from fogs and from dew in summer-time; winds occasionally strong, hot, and desiccating in summer and cold in winter.

LOCAL MODIFICATIONS.—The term "valley climate" is broad and includes everything from the coast to a certain elevation on the slope of the mountains. Certain small valleys protected from cold northerly winds and from fog-bearing westerly winds and open to the spring sunshine, have a forcing climate which produces the earliest maturing fruit of the season; earlier not only than the coast and the mountain but also somewhat earlier than adjacent locations in the broad, open valley. Slight elevation, even on the sides of small valleys, frequently secures freedom from winter frosts and ministers to early ripening. Elevation above sea level on the rims of great valleys also secures similar results and gives rise to thermal belts in which semi-tropical fruits are successfully growing even as far north as Shasta County. On the floors of great valleys moderating influences are secured on the lee side of wide rivers and by planting on the river bank or on slightly elevated swells rather than on the level, open plain. The river bottom lands of the great valleys, though subject to severe frosts, are freer from the effects of desiccating winds than the open plains; they are, however, more favorable to the spread of certain blights than the plains are.

Some of the horticultural effects of valley conditions are as follows:—

Early ripening and perfection of summer and autumn fruits, owing to continual sunshine and dry air; forced maturity of certain late fruits, as apples and pears, which destroys character and keeping quality; injury from sunburn and hot winds in summer, which seriously affect both fruit and foliage of some varieties; occasional injury to tender fruits (semi-tropicals) and to young trees of hardy fruits, which have been kept growing late in the season, from low temperature, which sometimes is reached suddenly on the floor of the valleys; freedom from some blights and insects which are prevalent on the coast, but not from others. Many of these minor troubles are, however, counterbalanced by the earliness, size, beauty, and quality of certain fruits, and by the most rapid and successful open-air drying of fruits, owing to high autumn temperature, the freedom from fog, dew, and generally from rain during the drying season.

FOOT-HILL CLIMATE.

Foot-hill climate is usually considered as a modification of valley climate. It has been shown that up to about two thousand five hundred feet, on the western slope of the Sierra Nevada, the seasonal temperatures are quite like those of the valley, but the rainfall increases about one inch for each hundred feet of elevation. There are, however, in the foot-hills places where early spring heat and freedom from frost give very early ripening fruits, and other places at the same elevation where winter temperature drops below the valley minimum, and where late frosts also prevail. This is governed by local topography. In many of the small valleys among the foot-hills, bordering upon the great central valley of the State, and in the Coast Range as well, frosts are more severe than the hills adjacent. The portions of these highland valleys most affected are usually the very lowest, the moist lands of the creek bottoms, or the wet swales, where there are such. Growths on the black or dark-colored soils, which are so situated as to be well drained and warm, are liable to frost, while those on the red lands and those of a chalky or ashen hue escape. The direct rays of the sun upon the darker earth hasten the spring growth beyond that on soil of lighter color. Hence if, other causes combining, there comes a frost, the earlier vegetation of the dark land suffers more than adjoining lands of a different description. These sudden changes to either extreme occur on the low grounds of the foot-hills to a far greater extent than upon the surrounding hills and ridges, or in the broad valleys of the Sacramento and San Joaquin.

Of course the disposition of cold air to settle in low places and to flow down cañons and creek beds while the warm air rises and bathes the adjacent hill-sides, has much to do with the frost in the hollow and the freedom from it on the hills, irrespective of color or character of soil. The constant motion of the air on the slopes is also a preventive of frost, providing the general temperature is not too low. It is not uncommon to find in deeper valleys, protected against the western wind, flecks of snow and a wintry chill, with dormant vegetation, while one thousand feet higher up the foliage is fast developing.*

MOUNTAIN CLIMATE.

Above an elevation of two thousand five hundred to three thousand feet, conditions gradually intrude which resemble those of wintry climates. The tender fruits, the apricot, peach, etc., become liable to winter injury and give irregular returns, or, as greater elevation is attained, become wholly untrustworthy. At four thousand to four thousand five hundred feet the hardy apple and pear flourish, ripening late, and winter varieties possessing excellent keeping qualities. Here, however, winter killing of trees begins and locations even for hardy fruits have to be chosen with circumspection.

There are elevated tracts of large extent among the Sierras, where the common wild plum, the choke-cherry, gooseberry, and California chestnut are produced abundantly. April frosts have killed the fruit of those same plums, transplanted to lower ground, while those left growing in their natural situation were quite unharmed. It has been observed that these plum trees, with other fruits and nuts in their original positions, invariably occupy the broad tops of the great ridges instead of the sides and bottoms of ravines or narrow, pent-up valleys. Follow nature in the choice of orchard sites (with due regard to a supply of moisture in the soil, either natural or artificial) and little hazard attends the culture of the hardier fruits of our latitude among the highlands of the State than is incident to other seemingly more favored localities. The beauty and quality of these mountain fruits are proverbial.

On mountain fruit lands snow sometimes falls to a depth of four to five feet, some years almost none, and during the open winter fruit-trees bloom out and are caught by subsequent frosts. This is sometimes prevented by covering the ground around the trees with a coating of leaves or well-rotted manure, several inches in thickness, which prevents the warming of the soil and thus retards the vegetative process. Where there is apt to be a

*E. W. Hilgard, Rep. 1889.

warm spell in midwinter, the snow in early winter is packed down and covered as described. This prevents the snow from thawing and consequently the ground is kept cold.

A RULE OF GENERAL APPLICATION.

What has been thus suggested of the great variation of temperature conditions within narrow limits should lead to the conclusion that not only must the kind of fruit to plant be determined by local observation and experience but often varieties of these fruits must be chosen with reference to adaptation to local environment. For this reason it is impossible to compile tables of varieties suited for wide areas—and yet it is true that some varieties have shown themselves hardy and satisfactory under all conditions. These facts will be shown by the discussion which will be given to each of the different fruits.

DATES OF FROSTS AND FIRST BLOSSOMS.

To show the distant reader the blooming season of California fruit-trees in the valley and the limits of the frost season, the following table is prepared from records kept for twenty-one years by S. H. Gerrish, of Sacramento, as published by Sergeant Barwick:*

DATE OF FIRST AND LAST LIGHT AND KILLING FROSTS, AND DATE OF BLOOMING FRUIT TREES IN SACRAMENTO.

YEAR.	First Light Frost.	Min. Temp. at First Light Frost.	First Killing Frost.	Min. Temp. at First Killing Frost.	Last Light Frost.	Min. Temp. at Last Light Frost.	Last Killing Frost.	Min. Temp. at Last Killing Frost.	First Fruit Tree Blossoms.
1869-70.....	Nov. 8, '69	40	Nov. 30, '69	31	May 17, '70	41	Mar. 8, '70	31	Feb. 21, '70
1870-71.....	Oct. 24, '70	36	Oct. 27, '70	30	Apr. 19, '71	40	Mar. 18, '71	31	Mar. 8, '71
1871-72.....	Oct. 25, '71	37	Nov. 6, '71	30	Apr. 12, '72	38	Jan. 9, '72	27	Feb. 26, '72
1872-73.....	Oct. 22, '72	37	Nov. 10, '72	27	Apr. 6, '73	34	Apr. 5, '73	27	Feb. 16, '73
1873-74.....	Oct. 16, '73	33	Oct. 17, '73	31	Apr. 14, '74	38	Mar. 19, '74	28	Feb. 14, '74
1874-75.....	Oct. 29, '74	39	Nov. 20, '74	29	Apr. 7, '75	31	Apr. 6, '75	24	Feb. 21, '75
1875-76.....	Oct. 28, '75	38	.....	35	Apr. 8, '76	38	Jan. 16, '76	29	Feb. 20, '76
1876-77.....	Nov. 3, '76	36	Nov. 13, '76	29	Apr. 23, '77	42	Feb. 11, '77	32	Feb. 2, '77
1877-78	Oct. 31, '77	33	Nov. 1, '87	31	Mar. 9, '78	39	Jan. 12, '78	30	Feb. 1, '78
1878-79.....	Oct. 16, '78	37	Oct. 28, '78	29	Apr. 15, '79	41	Feb. 6, '79	27	Feb. 15, '79
1879-80.....	Oct. 8, '79	39	Nov. 27, '79	25	Apr. 18, '80	37	Mar. 30, '80	28	Feb. 29, '80
1880-81.....	Oct. 31, '80	35	Nov. 13, '80	28	Mar. 18, '81	33	Mar. 17, '81	31	Feb. 22, '81
1881-82.....	Oct. 4, '81	36	Nov. 11, '81	30	May 15, '82	41	Mar. 9, '82	29	Feb. 28, '82
1882-83.....	Oct. 5, '82	42	Nov. 13, '82	27	May 2, '83	41	Feb. 18, '83	29	Feb. 19, '83
1883-84.....	Oct. 16, '83	39	Nov. 4, '83	31	Apr. 17, '84	43	Feb. 18, '84	31	Feb. 20, '84
1884-85.. ..	Sept. 30, '84	41	Nov. 30, '84	31	Apr. 22, '85	41	Jan. 26, '85	31	Feb. 10, '85
1885-86	Oct. 11, '85	38	....	34	Apr. 14, '86	39	Jan. 10, '86	27	Feb. 8, '86
1886-87	Oct. 9, '86	40	Nov. 4, '86	32	May 10. '87	34	Feb. 26, '87	26	Jan. 28, '87
1887-88.....	Oct. 20, '8-	37	Nov. 25, '87	28	Ap . 26, '88	38	Feb. 3, '88	28	Jan. 20, '88
1888-89.....	Oct. 19, '88	37	Nov. 6, '88	28	Mar. 14, '89	34	Feb. 19, '89	26	Feb. 3, '89
1889-90.....	Oct. 29, '89	36	Dec. 29, '89	27	.....	..	Feb. 28, '90	25	Feb. 13, '90

*Report of Agricultural Society, 1890, p. 376.

REST AND ACTIVITY OF FRUIT TREES.

Indication has already been made of regions adapted to the growth of early and of late fruits. There is of course difference in the time of rest and of returning activity in blooming. On the mountains under wintry conditions the trees leaf out and bloom late, following more or less the habit of Eastern trees. In the foot-hills, the valleys, and the coast, there is less difference in time of rest and of leaf and bloom. Even in regions where there may be a month's difference in ripening of fruit, as, for example, in the Vacaville district, fifty miles inland, and in Berkeley, two miles from the bay shore, trees bloom almost at the same date. The difference in ripening is due to the higher temperature and fuller sunshine of the interior situation, which have a forcing effect, while the low temperature and dull skies of the summer on the coast retard maturity.

The rest of the tree, in all save the mountain district, is not dependent upon the touch of frost. It comes rather from weariness and thirst than from cold. The immense weight of fruit, and the vigorous growth of wood, lead the tree to call for rest, and the exhaustion of the moisture from the soil by the draught of the roots to compass this growth, are the chief causes which bring the sere and yellow leaf in California. It is not frost, for the petunias may be blooming and the tomato vines still green in the fields. But the time has come for a rest. The trees sleep; but it is merely as a nap at midday; the early rains wake them soon. The roots are active first, then the buds swell, and the blossoms burst forth—sometimes as early as January—the almond first heralding the advent of California spring-time.

Sometimes this season of rest is too short for the good of the tree or vine. The early rains, when followed by a spring-like temperature, as sometimes happens, induce activity in the top as well as the root, and the tree is not in condition to withstand cold weather, which may follow. It is probable that such stimulated activity, suddenly checked, is responsible for more ills to tree and vine than are usually attributed to it.

CHAPTER II.

WHY THE CALIFORNIA CLIMATE SPECIALLY FAVORS THE GROWTH OF FRUIT.

The study of climate from a horticultural point of view has engaged the attention of some of the best observers and closest thinkers, and yet the work is far from finished; in fact, it seems now quite certain that very important agencies have been until recently overlooked, or too little prized. Such being the fact, the best course to pursue will be to measure the climate of California both by old and new standards, and if favorable results are shown by both, the adjustment of the relations between the two standards may be left for progress in climatology to accomplish.

It was pointed out by the earliest students of meteorology, as related to horticulture, that perfect development of fruits depends upon certain atmospheric conditions, which are included in the term climate: First, temperature; second, light; third, humidity or atmospheric moisture,—considered wholly apart from soil moisture. It was also shown that temperature and humidity should be equable, or as free as possible from excessive extremes or rapid changes.

Obviously, the chief characteristics of the California climate are: First, freedom from extremes of low temperature; second, an abundance of sunshine; and third, an atmosphere with a low percentage of humidity. It will be interesting to introduce enough statistics to demonstrate these claims, and to cite reasons why these conditions are of special value to the fruit grower.

THE OFFICE OF HEAT IN FRUIT PRODUCTION.

Temperature conditions may preclude the success of a fruit-tree either by destroying it outright, by dwarfing it, or by preventing it from ripening its fruit. Extremes of temperature accomplish the death of plants, and insufficient or excessive mean temperatures may prevent fruition without killing the plant. The first quality of the California climate to arrest the attention of fruit growers in the States east of the Rocky Mountains is the freedom from the effects of extremely low winter temperatures, to which is due the deplorable failure, in the Eastern and Western States, of many of the fruit varieties from the west of Europe, and to escape which such zealous effort is now being put forth to secure hardy varieties of native and foreign origin.

How slight is the injury from low temperatures in all parts of the State where fruit is largely grown, is shown by the fact that the lowest temperature known since American occupation, which occurred in January, 1888, did not, as a rule, injure mature wood of the orange and olive, though the more tender lemon and lime were often seriously injured, and in some places killed. Just what the extreme low temperature was at different points may be seen from the following compilation, taking points approximately at the same latitude on the coast, in the interior valleys, and on the foot-hills.

LOWEST TEMPERATURE AT SEVERAL CALIFORNIA POINTS.

Coast and Coast Valleys.	Degrees Above Zero.	Interior Valleys.	Degrees Above Zero.	Foot-hills.	Degrees Above Zero.
Eureka	20	Redding	18		..
Cape Mendocino	28	Red Bluff	16		..
Hydesville	24	Oroville	20		..
Napa	20	Marysville	18	Colfax	16
San Francisco	28	Sacramento	19	Auburn	13
San Jose	22	Merced	20		..
Gilroy	20	Fresno	18		..
San Miguel	17	Tulare City	14	Lewis Valley	22
Los Angeles	28	Riverside	25		..
San Diego	32	Poway	21	Fall Brook	27

These records will show anyone familiar with winter killing of the leading orchard fruits that such disasters are not to be feared in the chief fruit regions of California. Local temperature is largely controlled by local conditions, as has been already pointed out, and in the districts named in the table there are special locations where the lowest temperature probably differed a few degrees from the figures given.

NECESSITY OF ADEQUATE SUMMER HEAT.

Passing beyond the freedom from winter killing, it may be remarked that the influence of certain degrees of heat upon the growth of the plant and the perfection of its fruit, has been the subject of much close observation. Boussingault conducted careful experiments, and showed that a temperature above a certain minimum of heat is found necessary for germination, another for chemical modification, and a third for flowering, a fourth for the ripening of seeds, a fifth for the elaboration of the saccharine juices, and a sixth for the development of aroma or bouquet.

Originally the mean annual temperature was alone observed, and the polar limits of plants, it was presumed, could be thereby determined. More recently it was taught that the mean tem-

perature of seasons is of more importance than that of the year, and it is believed that to the relative distribution of heat over the seasons rather than to the absolute amount received during the year, we are to attribute the fitness or unfitness of a region for the growth of certain kinds of vegetation.

It is held in Europe that the mean heat of the cycle of vegetation of the vine must be at least 59° Fahr., and that of the summer from 65° to 66° Fahr. It is stated to be impossible, for instance, to cultivate the vine upon the temperate table-lands of South America, where they enjoy a mean temperature of 62.6° to 66.2° Fahr., because these climates are characterized by a constancy of temperature, never rising to the higher heats necessary to the process of sugar forming, and the vine grows, and flourishes, but the grapes never become thoroughly ripe. Boussingault shows that, in addition to a summer and autumn sufficiently hot, it is indispensable that at a given period—that which follows the appearance of the seeds—there should be a month the mean temperature of which does not fall below 66.2° Fahr. As will appear presently, this temperature test should not be taken alone, but it will serve as a standard to show one feature of the horticultural adaptation of the California climate. Boussingault claims the need of 66.2° Fahr. for a single month. To be sure to include this, the following table gives the average summer temperature at the leading fruit-growing centers named:—

AVERAGE SUMMER TEMPERATURE AT VARIOUS CALIFORNIA POINTS.

Coast and Coast Valleys.	Deg. Fahr.	Interior Valleys.	Deg. Fahr.	Foot-hills.	Elevation.	Deg. Fahr.
Napa.....	69.6	Redding	81	Auburn.....	1,363....	74.3
.....	....	Oroville	79	Colfax.....	2 421....	76
Livermore.....	70.8	Marysville.....	78	Georgetown.....	2,500....	85
San Jose.....	66.2	Sacramento	71.7	Caliente	1,290....	82.8
Hollister.....	67.1	Merced	78 4	Fall Brook.....	700....	68.2
Santa Barbara...	67.7	Fresno.....	84.1	.....	.....	....
Los Angeles.....	67.8	Tulare.....	83.4	.....	.....	....
San Diego.....	66.8	Riverside	73.7	.....	.....	....

These points are selected because the European varieties of the grape reach perfection in the vicinity. Boussingault's measure of fitness would condemn points directly on the coast where the summer temperature is approximately that of San Francisco (58.5°), and it has been found by experience that such a summer temperature really does not favor the ripening of the grape. The excess of heat above that required, as is found at all the interior points mentioned in the table, results in a very high sugar percentage in the grapes, and contributes to the ripening of a second and third crop, as will be noted presently. The superior length of the growing season in California, of course, is an important agency toward the same end.

DIRECT SUNLIGHT ALSO A REQUISITE.

Count de Gasparin, who is called illustrious, and the founder of agricultural meteorology, was first to point out that not alone sufficient heat but abundance of continuous sunshine was a requisite of perfection in fruit growth and ripening, and on his authority may be based a claim of exceptional value to the fruit grower in the months of cloudless skies which are characteristic of the California summer.

"The solar rays," says Gasparin, "do not only produce heat but bring us light, and the effects of the heat and light rays differ in a very pronounced manner. Without light there is no fructification; it is not necessary that the want of light should be complete that there should be a failure of fruits. In fact, diffused light alone does not suffice for the greater number of plants; cultivated plants will not ripen their seed without the direct rays of the sun, and the longer they are deprived of it the smaller the quantity which they will mature." *

Again, referring to the grape, for in connection with the growth of this fruit the most careful researches have been made, Humboldt wrote: "If to give a potable wine the vine shuns the islands and nearly all sea-coasts, even those of the West, the cause is not only in the moderate heat of summer upon the seashore, but it exists more in the difference which there is between direct and diffused light; between a clear sky, and one veiled with clouds." †

These suggestions of the eminent observers of the last generation have led to more careful observation of sunlight records as well as temperature records. Marie Davy, who leads in these observations in France, shows that the wine of the year 1875 was not of first quality, although the heat was great, and attributes the poor quality to the fact that the light record was small. The record thus compares:—

	1873.	1874.	1875.
Heat	2.146	2.169	2.220
Light	5.466	5.413	4.995

In 1875 the heat record indicated good quality, the light record poor; the wine was poor. Hence concludes Davy: "There can be no doubt of the preponderating influence of light on the fructification of the vine, notwithstanding the high temperature that this plant requires is indispensable." ‡

The results attained in France in observing the influence of direct sunlight upon vegetation induced the United States Sig-

*Cours d'Agriculture, t. II, p. 96.
†Cosmos, t. I, p. 349.
‡Meteorologie et physique agricoles (Journal d'Agric. Pratique 1875), quoted in Report U. S. Signal Office, 1881, p. 1196.

nal Service to undertake actino-metric observations, and it was decided to establish stations for such observations in California. There seems to have been trouble in securing proper instruments for measuring light force, and recent reports of the Signal Service do not indicate that the work was ever undertaken in the field. Fortunately, however, there is another method of reaching conclusive results, and that is in presenting the record of clear and cloudy days.

Notice first the conclusions of another eminent French physicist and botanist, De Candolle, as to meteorological conditions favoring the perfect growth and fruitage of the European grape species (*vinifera*). He showed that the vegetation of the vine begins at 50° Fahr., and matures its fruit in those localities which exhibit the sum of 14,500 degrees of heat from the day when growth commences with the mean of 50° in the shade to that on which this mean ceases, *providing the number of rainy days does not exceed twelve days in each month.* Here appears the importance of our abundance of bright light, as well as heat, because De Candolle found it truer to state the limit of rainy, that is dark, days rather than the amount of rainfall. The mean condition of the sky as more or less cloudy is a very important circumstance, because, as the number of rainy days increases, not only is the heat decreased but the chemical effect of the direct rays of the sun is impaired. How California stands in respect to this dictum of De Candolle concerning the number of rainy or cloudy days admissible during the growing and ripening season of the vine, can be seen from the following statement of the rainy and cloudy days at Sacramento during the spring and summer months, for a period of years:—

NUMBER OF RAINY AND CLOUDY DAYS AT SACRAMENTO FOR A SERIES OF YEARS.

	Spring Months.		Summer Months.		Fall Months.		Totals.	Monthly Average.
	Rainy.	Cloudy.	Rainy.	Cloudy.	Rainy.	Cloudy.		
1878..	21	19	None.	None.	7	4	51	5.6
1879..	32	19	3	None.	13	12	79	8.8
1880..	27	19	2	None.	2	6	56	6.2
1881..	16	10	3	5	12	3	49	5.4
1882..	25	16	2	1	16	8	68	7.5
1883..	24	12	None.	None.	14	6	56	6.2
1884..	27	23	8	6	9	3	76	8.5
1885..	11	6	3	1	25	17	63	7.0
1886..	26	12	None.	None.	7	1	46	5.1
1887..	17	6	1	None.	7	3	34	3 8
1888..	19	10	4	4	9	9	55	6.1
1889..	28	23	1	1	18	15	84	9.3
Monthly average for twelve years.....								6.6

Thus it appears by taking not only all days on which rain fell, but all cloudy days besides, including also the months of March and November, which give the greatest numbers of these days, and yet at a time when they can do the least harm, we find that California has hardly more than half the number of dark days which De Candolle considers admissible for the proper ripening of the *vinifera* species. This excess of advantage, as it may be termed, in connection with the high and protracted heat already mentioned, takes practical form in the successful ripening of a second and sometimes a third crop of these grapes in a season, which, with table and raisin grapes, at least are of considerable importance and value. Another indication of excess of advantage in the interior valley is found in the development of high sugar contents, which is of direct value in raisin production. The same tendency, though perhaps of less commercial value, is seen in the fact that some grapes which yield a good claret wine nearer the coast develop too much alcohol when grown in the interior.

The advantage of California over Eastern and Southern fruit regions in the abundance of clear sunshine is shown by the records of the United States Signal Service in the following table. Cloudiness is rated from 0 to 10, three observations daily, and the figures in the table are the averages from these daily observations for a series of years:—

AVERAGE CLOUDINESS IN CALIFORNIA AND IN THE EASTERN FRUIT REGIONS. ALSO AVERAGE TOTAL NUMBER OF CLEAR DAYS ANNUALLY.

California.	Average Cloudiness.	Clear Days.	Eastern and Southern States.	Average Cloudiness.	Clear Days.
San Francisco	4.1	147	New York	5.1	100
Los Angeles	3.4	171	Philadelphia	5.0	106
San Diego	4.2	122	Baltimore	5.0	109
Red Bluff	2.8	228	Rochester, N. Y.	6.9	71
Sacramento	2.5	240	Cleveland, Ohio	5.7	84
Oroville	No record	264	Grand Haven, Mich.	5.6	92
Nicolaus	No record	248	Jacksonville, Fla.	4.4	124
			Augusta, Ga.	4.6	127
			New Orleans	4.8	112

It is noticeable that at the California coast points the average cloudiness is almost twice that of the interior valleys, while at the East the interior fruit regions of Western New York, Ohio, and Michigan, have a greater average cloudiness than the Hudson River, New Jersey, and Delaware regions near the Atlantic seaboard. The average cloudiness in the Eastern fruit regions is rather more than twice as great as in the regions of California where most fruit is grown.

RELATION OF ATMOSPHERIC HUMIDITY TO THE GROWTH OF FRUIT.

There is another important condition of the climate of California which is intimately related to those which have been considered, and which is to be credited with no small influence in the perfection of our fruits, and that is the low percentage of humidity which our atmosphere contains. In California the percentage of humidity is high in the winter and low in the summer; in the East the condition is just reversed. For this reason summer heat is far more oppressive in the East than in California, and for the same reason certain serious fungoid diseases which prevail at the East, though found here in less injurious degree directly on the coast, are wholly unknown in the interior, where the air is drier. The dry air also favors the access and action of light and heat, for Tyndall says that a sheet of vapor acts as a screen to the earth, being in a great measure impervious to heat.

It is not necessary then that there should be clouds to lessen the chemical effects of sun heat in fruit ripening. Not only do clouds intercept sunshine, but watery vapor in the air—when to the eye the sun is bright as ever—can absorb a large quantity of the effective sun rays, and so retard fruit ripening. Hence an apparently sunny country which has much invisible watery vapor in the air, may prove defective in fruit-ripening qualities.

It is true that air free from humidity allows rapid escape of heat by radiation as well as free access of it, and in dry air frost is more severe, but at the time of the greatest fruit growth, from June to October, radiation down to a frost point is prevented by other natural agencies. In the early spring and late autumn the humidity percentage rises again and checks radiation just at the time of the year when it is most desirable to have it checked.

Returning once more to the studies of the growth and fruitage of the grape, we find data for insisting strongly upon the value of our dry summer air to the fruit grower. De Candolle concluded that so far as the temperature and sunlight was concerned, the *vinifera* might succeed in the Mississippi Valley, so their failure could not be traced to the causes which placed limitations upon the spread of the species in Europe. Other causes were sought for, and according to Lippincott* it is to excessive atmospheric humidity, alternating with aridity, and both together combined with high temperature, that must be ascribed the failure of the European grape-vine. Mr. Lippincott gives an item of his own experience in New Jersey which illustrates his claim:

*Report Department of Agriculture, 1863, p. 488.

The first half of September, 1865, appeared to be very unpropitious for the grape, mildew and rot having done their worst with the native vines, and the foreign under glass alone remained on which their destructive agency could work. From the 1st to the 15th the absolute and relative humidity were excessive, and the 14th was among the most oppressive ever remembered and recorded by the writer, frequently arising to saturation. Though the heat was not in excess, the abundant moisture rendered some of the above days painful to endure, the feeling being, at times, that of immersion in a steam bath. Our black Hamburg grapes which had not already ripened under glass, were dissolved in a mass of rottenness in consequence of suffocation in this vapor-laden atmosphere.

Much more could be said, but space will not allow a full discussion of the subject. The following table, compiled from the records of the United States Signal Service office,* shows the prevailing relative humidity in the East and South and in California. The figures are means for five years, except at Fresno, California, where the office had been established but one year when the compilation was made:—

MEAN MONTHLY RELATIVE HUMIDITY—APRIL TO DECEMBER, AND ANNUAL.

STATIONS.	April....	May.....	June....	July.....	August	Sept....	Oct.....	Nov.....	Dec.....	Mean Annual (12 Mos.)
Jacksonville, Fla.....	68.5	70.5	71.7	73.2	75.7	77.4	77.1	76.5	76 0	73.4
Philadelphia, Pa.....	68.2	74.0	72.8	70.8	73 6	72.7	72.3	69.7	74.9	72.3
Rochester, N. Y.....	6·.6	67.6	67.9	68.5	68.4	69 8	73.3	75.5	80.6	72.6
Grand Haven, Mich.....	68.0	68.5	73.5	75.1	77.2	75.9	76.4	77.1	80 9	75.8
St. Louis, Mo.....	67.7	73.0	75 2	69.9	69.6	68.1	76.0	72.6	76.7	73.0
New Orleans, La.	71.6	71.4	72.4	72.2	71.9	72.7	74.3	70.8	73.1	71.9
Galveston, Texas.....	77.9	76 4	74.1	73 8	73.3	74.1	75.9	77 3	79.6	77.0
Los Angeles, Cal.....	72.7	71.3	70.4	70.8	70.6	68.9	67 9	61.4	67.1	68.2
Fresno, Cal.....	56.6	57 9	51.8	45.5	38.0	49.1	50.3	64.8	78.2	60.2
Sacramento, Cal.....	70 7	64.1	61.6	56 8	58.3	57 9	66.6	69 4	83 4	67.4
Red Bluff, Cal.....	65.6	52.4	42.2	34.0	35.3	45.3	55 3	62.1	77.6	55.8

THE THREE POINTS COMBINED.

The three great advantages of the California climate,—abundant heat, continuous sunshine, and dry air,—taken in connection with the fitness of the soil and the great length of the growing season, insure the characteristic excellence of California fruit, and the early maturity, great growth, and abundant fruitage of our trees and vines. Heat, sunshine, dry air, and a rainless summer also minister directly to the curing of fruits in the open air. All things considered, it is doubtful whether any area of the world excels California in possession of natural adaptation to fruit production and preservation.

*For this and much other data used in this discussion I am indebted to Lieutenant J. E. Maxfield, formerly in charge U. S. Signal Service Office, San Francisco.

The characteristics of the California climate which have been especially pointed out in this sketch are not propitious to fruit culture when they exist to excessive degree, as is the case in the continental climate of Colorado, for example. A recent description of the climate of that State as related to tree growth* shows that, owing to local conditions of altitude, distance from the sea, and exposure to the sweep of Arctic winds, sudden and great weather changes occur, which are serious in their effects. Excessively low percentage of atmospheric humidity, in connection with desiccating wind, often produces greater evaporation from the leaves than the roots can supply. Excessively dry air admits a parching sun heat at one time, and at another facilitates radiation of heat, until the rapid decline in temperature makes killing frosts frequent. These and other ill effects are due to the constant tendency to excess in the Colorado climate. It is evident that California has these agencies constantly held in check by her insular situation and protecting environment, and owes her wonderful adaptation to growth of tree and perfection of fruit not more to the possession of certain conditions than to the fact of their existence in moderation.

*"The Climate of Colorado and Its Effects on Trees," by George H. Parsons, in Bulletin No. Forestry Division, U. S. Department of Agriculture, 1888.

CHAPTER III.

THE FRUIT SOILS OF CALIFORNIA.

THE favoring characteristics of the California climates, which have been described, find their fitting complement in the adaptation of the California soils to the perfect development of fruit-bearing tree and vine. In their wonderful variety and consequent great range of special adaptations within narrow limits of area, our soils also resemble our climates. As a man may sometimes find within the boundaries of an ordinary-sized farm such a difference of atmospheric conditions that the same fruit will thrive in one spot and not in another, so he may find differences in soil which will tend to produce the same results. For this reason the precise spot in which to plant any given fruit must be chosen with regard to both soil and exposure. In the chapters devoted to the several fruits, there will be an attempt made to describe the soil requirements of each, so that the inexperienced planter may not err seriously in choosing the location for each kind of fruit he desires to grow. While this is true, it will also appear in these special chapters that the choice of roots upon which to bud or graft gives the planter a certain latitude and independence. This is of greatest value in the planting of home orchards, or orchards for local markets, in regions where the soil is not what is usually preferred for fruit production. With proper choice of stocks and wisdom and diligence in cultivation, one need hardly despair of growing good fruit on any soil which will support any laudable plant growth. And yet in commercial orcharding, the secret of which is producing most abundantly and cheaply, too great attention cannot be paid to choice of specially-adapted soils.

The limits of this work will not admit the effort to describe California soils either very definitely or comprehensively, nor does the existing state of knowledge on the subject allow very accurate generalization. Though much has been learned practically, as it is hoped this book will show, of the requirements of different fruits and the way they are locally ministered to, no complete and systematic examination of California soils has yet been made. The importance of such a survey has been for years urged by E. W. Hilgard, Professor of Agriculture and Di-

rector of the Agricultural Experiment Stations of the University of California, and in anticipation of such a survey, and as a contribution to it, he has given all the time he could spare from many other and pressing duties, to the examination, and, when needed, the analysis, of representative soil specimens, and to practical expositions of their nature, adaptations, and requirements in the event of exhaustion from too long cropping. The public is therefore indebted to Professor Hilgard for whatever accurate knowledge exists on the subject. This information must be sought in a number of publications,* and no condensed outline of the work in its present state is available. It is the purpose of the writer to undertake a compilation, from these sources, of information which especially relates to the fruit soils of California, now known and used as such. The plan will be to collate the descriptions of the soils and their composition with the practical deductions therefrom, rather than the detailed analyses, for which the reader must be referred to the original source. The districting of the State for purposes of description is that devised by Professor Hilgard.

SOURCES OF CALIFORNIA SOILS.

As the rock is parent of the soil, a glance at the main geological features of the State is pertinent. Broadly speaking, the coast ranges of California consist of tertiary and cretaceous strata (mostly calcareous sandstones and more or less calcareous clay shales), almost everywhere greatly disturbed, folded, frequently highly metamorphosed and traversed by dikes of eruptive rocks. In the portion north of San Francisco these are frequently covered by tufaceous and scoriaceous or crystalline lava flows emanating from volcanic vents now extinct.

In contrast to the Coast Range, the Sierra Nevada has in general a central axis and locally lateral areas of granitic or other crystalline rocks (occasionally traversed by volcanic vents), on the flanks of which lie more or less crystalline and metamorphic slates or schists of paleozoic, triassic and jurassic age, with edges turned up at a high angle or sometimes vertical. These constitute the proverbial "bed rock" of the California miner. Abutting against this there lie on the eastern border of the great valley strata of marine deposits, mostly of tertiary, but northward of Folsom, Sacramento County, also of the cretaceous age, which are but slightly disturbed, and into which the rivers flowing from the canyons of the Sierra have cut their immediate

*Reports of the College of Agriculture, University of California, 1877 to 1890; report of Arid Lands Commission, 1882, United States Department of Agriculture; special part on California in "Cotton Report of Tenth Census," republished as "Agricultural Features of California," by Dewey & Co., publishers *Pacific Rural Press*, but now, unfortunately, out of print.

valleys, flanked by bluffs from forty to seventy feet high. From Tuolumne County northward, on the lower foot-hills, appear immense gravel beds, mostly gold-bearing, and these are partly overlaid by eruptive or volcanic outflows and tufaceous rocks, also accounted as belonging to the tertiary age. In the northern portion of the Sierra region the eruptive rocks become more and more prominent, covering an enormous area.

Apart from the cretaceous and tertiary beds on the borders of the great valley, there are, within the valley, terraces and bench-marks showing the existence, in quaternary times, of a great fresh-water lake. Borings in the interior valley disclose, for over two thousand feet, materials varying from fine silts to sands and gravels, evidently deposited in the ancient lake. The latest surface deposits are, in the San Joaquin Valley, mostly sandy; in the Sacramento Valley, particularly on the west side, more commonly clayey (adobe), corresponding to the composition of the Coast Ranges themselves, which in their interior southern portion show sandy materials more prevalently, while in the middle division clay shales are predominant and form correspondingly heavy soils.*

SOILS OF THE GREAT VALLEY.

The great valley of California, embracing a large proportion (one-third) of the agricultural lands of the State, is included between the foot-hills of the Sierra Nevada on the east and the Coast Range on the west, the general direction of its axis being nearly northwest and southeast. Its length from the Tejon Mountains, on the south, to Red Bluff, on the north, where the valley proper terminates, is about four hundred miles, while its width varies from over sixty to somewhat less than forty miles. Its total area is about seventeen thousand two hundred square miles.

This great valley with its tributary small valleys and the adjacent foot-hills on its eastern rim, which would of course materially increase the area as given above, contains about one-half of all the fruit-trees and more than one-third of all the grape-vines in the State. These trees and vines are closely grouped in small areas where the soil is known or imagined to especially favor their growth, or where irrigation facilities have already been secured. Outside of these areas the great plains are still vast stretches of grain or pasture land, and one can ride for hours without catching sight of orchard or vineyard.

In mentioning the fruit soils of the great valley special

*"Physical and Agricultural Features of California," p. 8.

reference will be made, not to the plains in general but to the districts where horticulture has gained a foothold.

FRUIT SOILS OF THE SACRAMENTO VALLEY.

ADOBE SOILS.—Thus far a very small area of the adobe* soils of the valley have been employed in horticulture, but results already attained indicate future extension in that direction. There is a great difference in the character of what is known as adobe in different localities. Its color varies, as the popular terms "black waxy," "black," "brown" and "gray" adobe indicate. Its physical condition and chemical composition also vary greatly. The black adobe of the east side of the Sacramento Valley is easily tilled as compared with the gray adobe on the west side, which is very refractory and often largely impregnated with alkali.

To render soil of adobe character useful for fruit growing, this tendency to dry out and crack, thus allowing evaporation from below as well as from the surface, must be overcome. The discussion of this point belongs to the chapter on "Cultivation."

Adobe soils are as a rule rich and durable and therefore promise long fruitfulness to trees and vines with roots adapted to heavy soils. They are sometimes, though not often, deficient in lime; and the addition of lime as a top-dressing, where its cost will warrant the outlay, not only makes the soil more easy of culture but unlocks and makes available new stores of plant food. Adobe is also improved physically by green-manuring, addition of sand, sifted coal ashes or other coarse materials, and where the rainfall is abundant, to facilitate decay even sawdust can be incorporated with the soil with beneficial results. On small areas of fruit where mulching is practicable very gratifying results have been attained by this method of retaining moisture.

LOAM SOILS.—As stated by Professor Hilgard, the prevalent soils of the Sacramento Valley are loams. On the east side low ridges and swales at right angles to the rivers' course come in from the foot-hills, forming a gently undulating plain with a fall of from fifteen to twenty feet per mile, sometimes right up to the river channels. Nearly all the soils of the east side have a reddish tinge, showing the admixture of the red foot-hill soil, and demonstrating, by the way, that all these lands are well drained. In cuts ten to twelve feet deep, made by the sloughs, the reddish plains loam is seen to reach from six to ten feet depth, being then underlaid by gravelly substrata. The width of this

* Adobe is the Spanish-Californian term for a heavy clay soil, although the material suitable for adobe walls is of a much lighter character.

class of profusely fertile valley land, east and west, varies considerably, according to the meanderings of the rivers. Away from the water courses, the higher lands of the valley are largely red or yellow loams, sometimes clayey and difficult of cultivation unless taken just in the right condition, sometimes gravelly and apt to dry out unless the natural water supply is supplemented by irrigation, but mostly a free-working, fairly retentive, light loam, very satisfactory for some kinds of fruit. So far, the acreage of fruit on these upland loams, except on occasional areas of the finest quality, is not large, but their future employment promises to be considerable. A conspicuous example of the employment of the best upland loams for fruit is found in Sacramento and Calaveras Counties, where, as described by Professor Hilgard, "southward of the American River and reaching across Cosumnes and Mokelumne to the Calaveras, extends a plain broken only by occasional swales of reddish soil running in from the foot-hills. This is one of the most productive and thickly-settled portions of the entire valley, the soil being mostly a dun-colored loam, varying in lightness, but throughout easily tilled."

In the upper part of the valley, on the east side and bordering on the foot-hills, there are some bodies of close-textured, light-yellow loam, which, in contrast to the deeper-tinted soils of the adjacent foot-hills, are very deficient in plant food and speedily become unprofitable as grain land. Their only chance for durability is in the growth of fruit, because of the deeper rooting of trees and vines, but even such growths will soon need fertilizers.

BED ROCK LANDS.*—Farther south we find on the eastern valley border the gravel plains or bed-rock land, underlaid by a non-alluvial, horizontally-stratified formation of grayish and whitish clays, that with varying width extends from near Chico, Butte County, southward across the Mokelumne, and probably at least as far south as the Stanislaus River, and at some points ascends several miles into the foot-hills themselves. The land, though not poor, is ill drained, and the soil heavy and of a tawny yellow; much of the surface is of the "hog-wallow" character,* and very gravelly; and during the wet season, and for some time thereafter, the surface is dotted with little ponds, forming an intricate network of slow streamlets, which keep up the green pasture for some time later than is the case on the alluvial lands. But when these surface waters once evaporate, the ground quickly dries up, and where tillage has not been

**Vide* Professor Hilgard's Report on Agr. Ex. Stations, 1890.

very deep and thorough, injury from drought is very likely to happen. Hence a large proportion of these lands, however attractive to the eye in their spring garb, is chiefly as yet devoted to pasture, and form a comparatively little settled and mostly treeless belt between the valley and foot-hill lands proper, wherever the impervious clays approach the surface. Fortunately, this is far from being the case everywhere, since both ancient and modern channels in great numbers traverse the belt, forming such fertile regions as the Ione Valley, and similar ones near Wheatland, Lincoln, and in the Mokelumne region. In Sacramento County this soil region is known as the "bed-rock lands," and has been very successfully used for fruit culture, by means of giant powder cartridges to break up the clayey "bed rock" beneath the holes in which trees are to be planted, as described in chapter II. The more general employment of this method, and the ultimate use of underdrains, will depend purely upon the increase in the value of fruit lands.

It has been found by experience that shattering this hardpan has not only relieved the roots from the effects of stagnant water, but has enabled them to penetrate strata containing much plant food. This method of planting will make a large area of shallow soil available for fruit, and it is applicable not alone to the lands in question but to all soils underlaid by a water-tight layer or hardpan, notably to the hardpan found in alkaline soils of the San Joaquin Valley, to which reference will be made presently.

The "gravel plains" soil from the Galt neighborhood differs pointedly from those just described in the nature of its substrata, none of which are quite as clayey or impervious as in the bed-rock lands, although, as it appears, a heavy deposit of red clay replaces the sandy strata said to underlie the "bed rock" in the latter. No heroic measures are called for in the gravel plains to render the substrata penetrable to roots; deep cultivation would probably accomplish most of the improvement needed in the mechanical condition of the land, and underdrains would relieve all trouble.

SEDIMENTARY OR SILTY SOILS.—These soils have been considered from the earliest plantings by Americans as *par excellence* the fruit soils of the great valley. They occur along the courses of existing streams, and extend back to variable distances, until they merge into the valley loams, or adobes. These deposits are considerably higher than the present beds of the streams, and are sometimes described as "next to river bottom." They consist of fine alluvium, with seldom any

admixture of coarse materials. These river soils are usually very deep, and they are naturally well drained. Of the chemical composition of these soils Professor Hilgard remarks:—

> A common characteristic is an adequate, and in some cases generous, supply of lime, which insures the availability of the plant food they contain, greatly enhances their power of resisting drought, and of forming and retaining humus, and renders them easily tillable, notwithstanding the great amount of clay they contain. The amount of potash is large, in some cases very large. In none of these soils, however, is the supply of phosphates large, and in some cases but for the liberal amount of lime would be considered deficient. Whenever their productiveness declines, phosphate fertilizers will evidently be first needed.

On the west side of the Sacramento River, and thence to the foot-hills of the Coast Range, there are areas of sedimentary soil of somewhat different origin and character. The rich alluvial plains of Yolo and Solano Counties possess soils of pre-eminent fertility, being a mixture of the finest natural sediments of the Sacramento River with those carried by streams heading in the volcanic region of the Coast Range. West of these are the sediments brought down by these streams without admixture of the Sacramento River sediment. These deposits cross the west side of the valley in somewhat irregular belts; they are of greater or less width according to the drainage area whence they have come. They vary also in depth, and taper down on either side to the level of the red loam or adobe upon which they have been deposited. Such strips are first chosen by the fruit planters of the district in which they occur. The success of these orchards has led later planters to venture upon the coarser loams or the finer-textured adobes which border the sedimentary streaks, and the success attained by good cultivation, and underdrainage when necessary, gives abundant data for the conclusion that wise choice of roots and skillful management of the soil renders far more of the valley available for fruit growing than was thought possible a few years ago.

Still farther west of the soils alluded to are the small valleys of the east side of the Coast Range, which open into the Sacramento Valley. Several of these valleys constitute what has become famous as the Vacaville fruit district. In these small valleys the soil of the valley proper is an alluvial wash derived from the red gravelly loams of the bordering hills, and in some places it reaches a depth of thirty feet or more without notable change in character. Usually the greater depth occurs near the head of the valley, and thence the deposit becomes shallower until the small valley debouches upon the great plain of the Sacramento with its prevailing loams and adobes. Even in these small valleys, however, there occur here and there spots of very different character, and places where the underlying

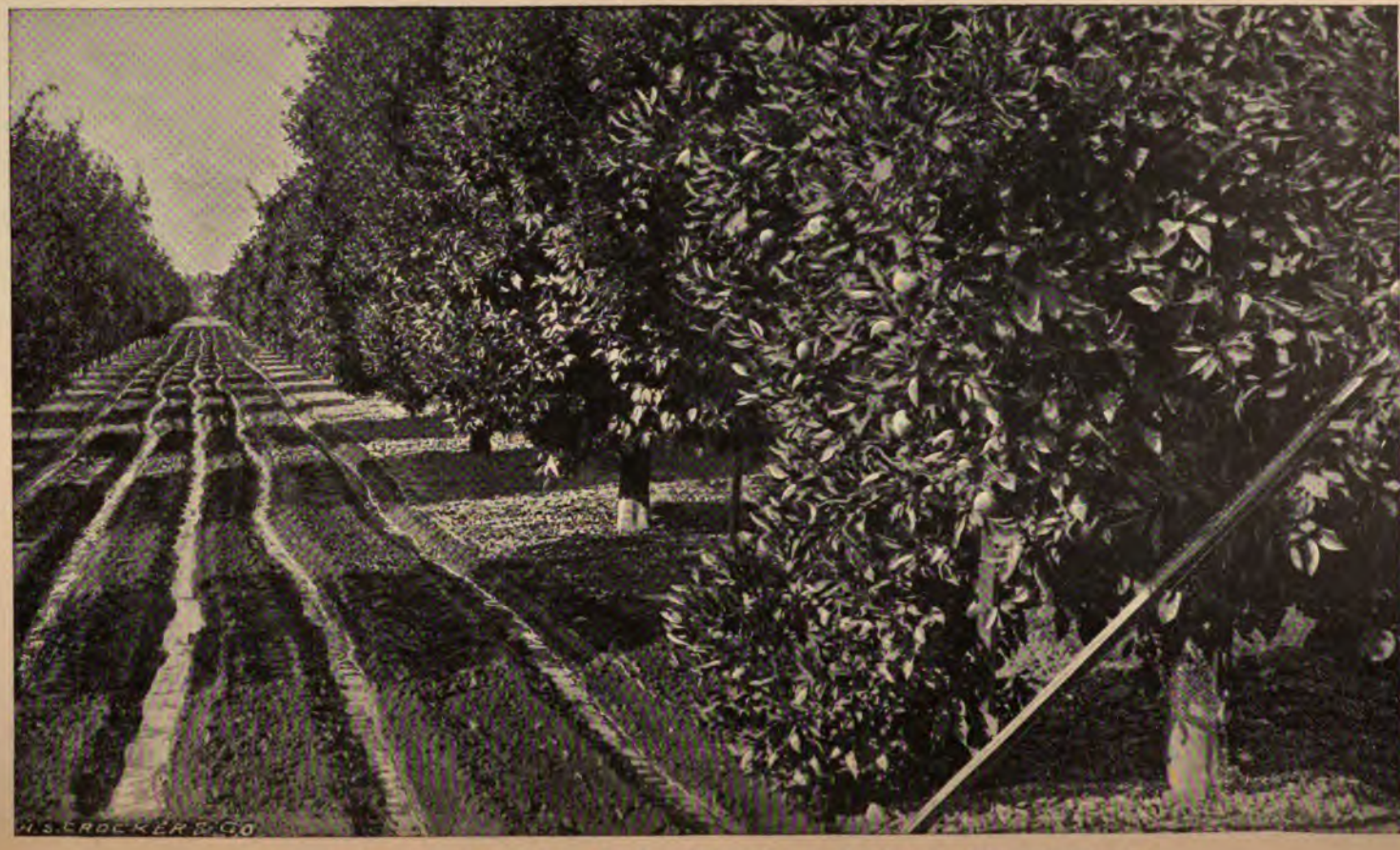
strata approach the surface. Professor Hilgard describes the Vaca Valley soils as rich in potash and lime, and having a good supply of humus. They are less well supplied with phosphoric acid. In both chemical and physical conditions (which insure ease of tillage) the Vaca Valley soils resemble the sedimentary soils of the main valley already described.

RIVER BOTTOM SOILS.—Below the "river banks" sedimentary soils, which is another name for the soils previously considered, lies the rich river bottom, adjacent to the beds of the main rivers and sloughs of the valley. It is usually a dark, rich, and moist soil, easily tilled and not subject to baking and cracking. It is largely used for the growth of vegetables and alfalfa, but considerable areas are now being planted with fruit trees, especially with pears, which do not suffer from submergence of their roots for considerable time. This is shown by the thrift and productiveness of some very old trees which now stand outside the levees. A great area of this soil has been destroyed by *débris* from hydraulic mining, which is now, however, illegal.

SOILS OF THE SAN JOAQUIN VALLEY.

Professor Hilgard makes the general statement that the soils of the San Joaquin Valley have, as a rule, a much greater admixture of sand than those of the Sacramento Valley; there is also a more distinct subdivision of the valley lands into upland or "bench" lands, and lowland or alluvial lands proper. The Stanislaus, Merced, and other rivers, after entering the great valley, meander in more or less extensive valleys of their own, which are often bordered by rather abrupt bluffs from forty to fifty feet high, falling off from rolling plateau lands abutting rather abruptly against the foot-hills of the Sierra. These plateau or "plains" lands have frequently a curiously-carved surface of little hillocks, from ten to thirty feet across, and from one to three feet high, closely dotting the surface, with only little drainage channels between, which are commonly floored with some gravel, or, at times, with cobble-stones, washed out of the subsoil. This hillocky land is popularly called "hog-wallows;" but the name does not properly designate a particular kind of soil (save locally), it being in some cases a heavy, gravelly clay, in others very sandy, though perhaps predominantly the material is of a loamy character, with the tendency to the formation of "hardpan." When the latter is somewhat pronounced, it renders the smoothing down of the surface for convenient cultivation rather troublesome. But all these soils are intrinsically rich in plant food.

It is upon these plain soils, especially of Fresno and Tulare



IRRIGATION BY FURROWS IN A RIVERSIDE ORANGE GROVE.—See page 213.

counties, that the wonderful progress in fruit-growing by irrigation has been made during the last few years. Though its summer aspect is most forbidding and almost desert-like in lack of vegetation, the application of water has shown exceptional quickness of growth, early bearing, and lavish productiveness of tree and vine. Though there are local problems still to be solved in securing drainage to prevent undue rise of the water level, etc., it is no stretch of the imagination to say that the desert has been transformed into a fruit garden.

FRESNO PLATEAU.—The soils of the Fresno plateau, which forms a broad-backed divide between the San Joaquin and Kings Rivers, have somewhat of a special character. Those of the Kings River side are represented by the "white-ash" soil of the Central, Washington, and other colonies, while those of the San Joaquin side are reddish sandy loams, contrasting pointedly with the "white-ash" lands. To eastward of Fresno City both kinds of land run out, as the foot-hills are approached, into the red lands hereafter referred to. Interspersed more or less with all these soils are low sandy ridges, quite irregularly disposed and locally known as "sand-hills," the sand of which is chiefly pure quartz, and forms rather an unsubstantial foundation for agriculture.

From Professor Hilgard's investigations of the plains soils the following general deductions are drawn:—

The white-ash soil of the Fresno plains is largely grayish white, somewhat ashy, changing little to the depth of two feet or more, then gradually becoming more sandy; sometimes underlaid at from one and a half to five feet depth by a sheet of calcareous hardpan, eight to thirty inches in thickness, that seems to be merely the subsoil cemented by lime. In planting trees it is sometimes necessary to break through this hardpan in order to enable the roots to reach moisture. This soil is said to be fairly representative of the country lying southward toward Kings River and westward to the valley trough. To the east and north it passes into the reddish loam and into the red lands of the valley border, formed by the streams coming from the foot-hills. The Tulare plains soil is prevalently of a dun color, quite light and sandy. All these soils are distinctly calcareous, and this accounts for the extraordinary thriftiness (under irrigation) of even such as do not show a high percentage of phosphates and potash. Almost throughout, the percentage of phosphoric acid in the soils of the San Joaquin Valley is only moderately high. While in the lowlands, more or less impregnated with alkali, both potash and phosphates are comparatively abundant, and will not require replacement for a long time to come, the phosphates will be the first to become exhausted in the uplands, when bone-meal and superphosphates will come into heavy demand. On the other hand, the use of lime as a fertilizer will scarcely ever be called for in the San Joaquin Valley, and potash manures will not be needed for a long time to come, even in the uplands, and never in the lowlands.

Though the summer aspect of the gray, dusty soil of the San Joaquin plains might give the impression that it is destitute of, or at least very poor in, humus or vegetable mold, the figures show that this is far from being the case, for even the white soil of the Fresno plains shows six-tenths of one per cent, and that of the sandy Tulare plains one per cent and over. It is the lime so abundant in these soils that helps to retain the humus, despite the prolonged action of the hot summer's sun.

SAND-HILL RIDGE SOILS.—The occurrence of these ridges has been mentioned. They are but slightly elevated above the general level of the country, and their sandy soil passes by gradations into the brown adobe bordering the foot-hill streams, or into the reddish light loam and "white-ash" soil of the country inland. In some cases their material was originally so loose as to be blown about by the winds. Since irrigation has been practiced, these sandy ridges have been noticed to grow over with rank weeds, and these gave a practical hint of the value of the soil, which has resulted in the planting of a considerable area with fruit, especially in the vicinity of Fresno City. After examination and analysis of the soil Professor Hilgard writes as follows:—

> It cannot be expected that in a soil containing ninety per cent of inert sand, large percentages of plant food should be found; and if the figures of desirable constituents referred to a clay soil, or to a sandy soil of little depth, little could be said for it. But when such sandy material is from six to ten feet and more in depth, and roots can penetrate it as fast as they can grow, the matter assumes a different aspect, since in that case the plant can and does utilize as a source of nourishment not (as is the case in close soils) twelve to twenty inches, but from three to eight feet, as is shown by inspection. To obtain the proper comparison with a clay soil, therefore, we should multiply the amounts of available plant food by three or four, which will give respectable percentages of all, and a very high one especially of lime. The sand-hill soil is eminently a calcareous one, and as such its plant food is in a highly available condition. But it is highly essential that its depth should not be impaired by the rise of the bottom water, as has sometimes been the case, with disastrous results.

In the lower lands of the country to northward of the Fresno plateau, on the San Joaquin and Fresno Rivers, as well as on Cottonwood Creek, we again find soils of a heavier grade and with large supplies of mineral plant food; but the investigation of this portion of the valley has not progressed far enough to justify any broader generalizations at this time.

RED LANDS OF THE VALLEY BORDER.—Along the base of the foot-hills of the Sierra there is in Fresno, Tulare, and part of Kern County, a belt of reddish or brown loam soils, corresponding to those similarly located in the Sacramento Valley, but generally more clayey, and hence frequently designated as adobe by contrast with the very sandy soils of the valley at large, although properly they should be classed simply as clayey loams. This belt is eight to ten miles wide in middle Tulare county, and narrows to the north and south. Here these lands have a gentle slope of ten to twenty feet per mile from the base of the foot-hills, and appear to be underlaid at a depth of twelve to fifteen feet by water-bearing gravel. The soil is a reddish, more or less sandy loam, changing little in its aspect for several feet, and produces excellent grain crops. Its adaptation to fruit

culture cannot be doubtful. This red land extends southward to Tule River (Porterville), and doubtless beyond, and also fills the adjacent valleys of the foot-hills. Northward it seems to be limited by a line running southward of Farmerville (Lewis Creek?), where a very sandy plain intervenes between Outside Creek and the foot-hills, south of the Yokol.

Farther northward, in Fresno County, the alluvial soil of the foot-hill streams (Fancher and other creeks) resembles closely the "red lands" just mentioned. The greater part of the well-known Eisen Vineyard, as well as the fruit farms lying north and south of the same, are on this soil. In Tulare and Kern Counties the area is mostly occupied by grain thus far, but it can hardly be doubted that here as elsewhere it will prove adapted to a high quality of orchard fruits, such as are now produced in the Porterville region.

THE ALLUVIAL SOILS OF THE SAN JOAQUIN.—Allusion has already been made to these soils in discussion of the plains soils. In the valleys of the rivers crossing the eastern side of the valley, there are, bordering the streams as well as Tulare Lake, considerable areas of brown to blackish loam varying from heavy to light, but for the most part easily tilled and exceedingly rich. Considerable fruit has been grown for years on these situations, and, as will be noted in the chapters on different fruits, some kinds do well on these bottoms which do not show adaptation to the plains. Some even of the higher lying portions of these "black lands" support thrifty orchards without irrigation. The wider stretches of alluvial soils in the upper part of the valley, as in the Mussel Slough country, for instance, are notably well adapted to fruit growing. The occasional intrusion of alkali, which must be carefully avoided, is the chief obstacle to the general approval of these alluvial lands for fruit purposes.

ADOBE SOILS.—There is on the whole but little of the heavier class of clay or adobe soils to be found in the San Joaquin Valley; what is currently so designated would in other regions sometimes be hardly classed as a clay loam. A narrow belt of dark-colored clay or adobe land extends from the neighborhood of Merced City toward Stockton, where, northward of French Camp Slough, and especially westward to the Coast Range, really heavy adobe or prairie soils prevail very largely. To southward of the line of San Joaquin County such heavy adobe soils are found only in the river trough, and the soils of the west side are prevalently sandy, all the way to the Tejon Mountains. The adobe shades off insensibly into the blackish loams known and esteemed in Tulare and Kern Counties as the "black lands," to which reference has just been made as alluvial soils.

ALKALINE SOILS.—The higher plains have very uniformly, from Kern County to Stanislaus, a very sandy loam soil, of great depth, and almost everywhere made up of granitic *débris* instead of quartz grains; hence are continually increasing their store of mineral plant food by the weathering of the minerals present, a process which in so porous a material, subject, in its natural condition, to free access of air during the greater part of the season, was evidently very rapid, and as a consequence has developed unusually large amounts of the soluble products, which often appear in an inconvenient abundance in the guise of "alkali." But little trouble arises from this cause in the high-lying, sandy tracts, where irrigation or the natural rainfall carries the soluble salts annually into the country drainage; but in the low-lying and less pervious soils of swales and valley troughs, which are at the same time intrinsically the richest in available mineral plant food, the accumulation frequently causes considerable trouble and difficulty. The soils containing white alkali only rarely require more than thorough tillage to render them unobjectionable for fruit culture, but the "black alkali" lands require special treatment.*

SOILS OF THE SIERRA FOOT-HILLS.

On the east side of the great valley are the foot-hills of the Sierra Nevada region, in which fruit culture is advancing rapidly. Professor Hilgard gives the following conclusions from his investigations:—

The *soils* of the foot-hill region are substantially of three kinds, corresponding to the chief rocks of the Sierra, viz.: those derived from granite proper, those formed from the slate "bed rock," and that resulting from the disintegration of the "blue trap" or "bastard rock" of the miners. Of the three soils mentioned the granite soil, while fairly productive, is the lightest and least durable; the trap soil is the most substantial, producing good grain crops, but is often quite shallow and stony, or full of cobbles, and correspondingly difficult of cultivation. The slate soil, while not as heavy or substantial, on the average, as the trap soil, but like it of a deep orange-red tint ("red foot-hill soil"), is the one most generally approved, especially for fruit culture, largely because even when it is shallow, cultivation soon deepens it by the disintegration of the bed rock, into which, since it stands steeply on edge, the roots of trees and vines readily penetrate, obtaining both moisture and mineral plant food.

It is a marked peculiarity of this typical red earth of the placer mines that it will assume the functions of a soil at once, even when taken from depths of seven to twelve feet. Hence it is that the lands worked over by the early miners, where they have not been subsequently overrun by gravel, or denuded of their red soil, soon become covered with the natural vegetation of the region.

Between these three types of soil there lie, of course, many transitions and intermixtures, which are frequently preferred to the typical soils themselves. As in all hilly countries, there are in the foot-hills stony tracts, in which the bed rock is either actually at or near the surface, or its fragments very abundantly intermixed

*University publications on alkaline soils and their treatment may be had by application to Agricultural Experiment Station, Berkeley.

with the soil and subsoil. In such lands the timber (oaks and pine) is either stunted or absent, and the same is true of the several kinds of "chaparral." Large, sturdy trees always indicate a considerable depth of soil sufficient for all agricultural purposes.

The red soils are highly charged with iron (ferric hydrate or rust) to the extent of from seven to over twelve per cent, which, being finely divided, imparts to them the intense orange-red tints so familiar in the region of the placer mines, and during the dry season manifesting itself in the equally familiar red dust that disguises the natural tints even on the trees themselves. The soils of the foot-hills, so far as have been analyzed, agree with the soils of the valley in having a good percentage of lime, from about one-third to one and a half per cent, while the supply of potash and phosphates, as well as of organic matter, is smaller, and sometimes low, though never apparently inadequate for present productiveness, in the presence of so much lime.

The light-colored granites yield light-colored soils, of a loose texture, that in general are more scantily provided with the elements of fertility than the red soils, and while yielding a high quality of fruits adapted to such soils (*e. g.*, peaches, cherries, etc.) are not very durable and soon require fertilization. They also require more water to prevent injury from drought.

Where the foot-hill soils either obtain a sufficiency of moisture naturally, or can be irrigated, they prove abundantly productive, and are rapidly acquiring a special reputation for the excellence of their fruit product, both of orchards and vineyards.

Analyses of foot-hill soils indicate quite a wide difference in probable duration of fertility because of great variation in amounts of desirable mineral ingredients. In many cases, however, where the yield of shallow-rooting plants soon shows impoverishment of the surface soil, the fertility of the subsoil and of underlying previous strata of disintegrating rock will long maintain deeply-rooting trees and vines.

It has also been shown that the foot-hill soils differ greatly in retention of moisture, and this fact should not be overlooked in the discussion which constantly prevails as to whether irrigation is necessary for fruit. The answer to the question must be according to the character and depth, above the bed rock, of certain specific soils, as well as according to the requirements of certain fruits.

Some of the larger valleys of the foot-hills (as E. G. Penn, Indian Springs, and other valleys in Nevada and Yuba Counties) have brown loam soils inferior to none in the State in productiveness, whose eminent adaptation to fruit culture has been long demonstrated by experience, on the small scale, but none the less convincing, since even the abandoned orchards continue to yield fair crops and have thrifty trees.

SOILS OF THE COAST RANGE.

The coast region of California consists for the most part of low ranges with intervening valleys. These valleys are, as a rule, small, though a few show considerable area. In such a country the soil surface shows wide diversity within smaller areas than on the vast stretches of the great interior valley;

consequently, so far as soil goes, the coast farms are often suited to a wider range of fruits than the interior valley farms of similar size, and especial care should be taken in laying out orchards to bring the different fruits upon the soil which best favors each. Concerning the soils of the Coast Range in general, Professor Hilgard says: "In the coast region there are about the same classes of soils as have already been described in the great valley and the Sierra foot-hill regions, but they are derived from a great variety of different rocks, often much localized, and are therefore very variable in composition." It will be pertinent to allude more specifically to the soils of the more famous fruit regions of the coast, which Professor Hilgard has examined.

REGION NORTH OF THE BAY.—In the important fruit regions of Santa Rosa Valley, and the small valleys which open into it, in the Russian River Valley and the Cloverdale region, the soils are not dissimilar to those of Sonoma and Napa Valleys, which lie to the eastward. We specify, however, the soils of the last two valleys because they have been more thoroughly examined.

In Sonoma Valley, lying near Sonoma Creek, is a medium light loam of a reddish-buff tint when dry, and blackish when wet. On the higher lands adjacent is the red mountain soil, a brownish-red loam containing rock fragments, light in tillage, evidently especially adapted to fruit culture, favoring early fruiting as well as early maturity—so far as early maturity is attainable near the coast. Of the comparative qualities of these two soils Professor Hilgard says:—

> While differing widely in their aspect and physical properties, and in some points of their chemical composition, these two soils are yet not very far apart in the most essential point—the supply of plant food. In its percentages of potash, phosphoric acid, and lime, the mountain soil stands somewhat below the valley soil, yet the supply of all three is fair. In humus the mountain soil exceeds that of the valley nearly one and a half times, and this, together with its extraordinary iron percentage, accounts for its very high power for absorbing moisture, that forms a very effective safeguard against injury from drought. On the whole, the advantages of the two soils are very evenly balanced, its location giving the valley soil a similar degree of security against drought; but it is evidently more liable to injury from frosts and wet than the hill soil. The latter, with its eastern exposure, seems certainly pre-eminently adapted to grape culture.

In Napa Valley and on the adjacent hill-sides there is a great variety of soils, from heavy black and gray adobe to light generous loams, sometimes gravelly. Some of the hill-side soils have been found quite deficient in fertility, lacking in potash, lime, and phosphoric acid; while others, like the hill-side soil from Sonoma Valley, just mentioned, and on the divide between

the two valleys, are very fertile and desirable. The valley soil near St. Helena, which has been analyzed, seems to warrant the following comparison:—

The Napa Valley soil differs from the Sonoma soils in two chief points. It is considerably richer in potash, and, on the other hand, considerably lower in phosphates, as well as lower in lime. It may be that in both these respects the cultivation it has undergone exerts a depressing influence upon the results. At the same time the abundant potash no doubt has some connection with the extraordinary crops sometimes grown in the Napa Valley.

ALAMEDA VALLEY.—The grand fruit region extending from the city of Oakland southward for nearly one hundred miles is one of the most important in the State. The northern part of this region is called the Alameda Valley. It lies east of San Francisco Bay. Of the soils of this valley Professor Hilgard says:—

Immediately along the bay shore lies a narrow strip of sandy land, sometimes sand drifts, which influence more or less the character of the adjacent marshes; most of the soils of the latter, however, are heavy, and when reclaimed are very productive. Inland of these lies a broad belt of black calcareous and very fertile adobe, somewhat refractory in tillage, which toward the foot of the hills often becomes yellow and relatively poor. This adobe belt is interrupted by the sediment lands of the streams flowing from the Coast Range to the bay, which are generally light and often of considerable width, although few of these streams are now of much importance; but the frequent shifting of their channels in past times has increased the alluvial surface. These sediment lands, frequently, of course, passing gradually into the adobe proper, are noted for their productiveness.

It is these deep and rich alluvial deposits which have given the San Leandro and San Lorenzo and Haywards regions their great fame for fruit products.

Farther south, in the Niles region, the loams are somewhat lighter, being the deposit of Alameda Creek, which has brought down the lighter materials from the Livermore Valley and the slopes of the Suñol Cañon. Of the soils of the Livermore Valley, which has recently made great progress in the growth of fruit, especially grapes, Professor Hilgard says:—

Analyses of three main divisions of the Livermore Valley, the rolling uplands, the bench lands, and the valley, show a wide difference between the uplands and the valley soil (from the Ojo del Monte). The latter has an extraordinary high percentage of potash, a very large one of lime, and a fair one of phosphoric acid, but is very poor in humus. In the upland soils, which differ very little from each other in composition, the supply of potash is less than one-third as high as in the valley, that of lime somewhat over one-third, while the phosphoric acid is only about one-half as high, and but just above the usual limit of deficiency. The limit is past in the case of the bench soil, in which the supply of phosphates is quite deficient. Hence the difference between the thriftiness of the vines on the bench and in the valley is sufficiently accounted for, and the remedy is the use of bone meal. As regards the uplands, the relatively considerable supply of lime will probably maintain the needful supply of available phosphoric acid for some years; but with them also the use of bone meal or other phosphate fertilizers will be among the first things called for when the vines have borne for some years.

SOILS AROUND THE MISSION SAN JOSE.—Near the imaginary boundary between the Alameda and Santa Clara Valleys, upon a promontory of low hills extending from the foothills of the Coast Range about two miles into the Alameda Valley, the old Mission San Jose was located by the padres, and its orchard and vineyard were famous, even after the American occupation. Its elevated site secures freedom from frosts which visit the valley adjacent. Within the last few years there has been great extension of the fruit interest in the neighborhood of the Mission and the Warm Springs, especially in the growth of wine grapes. A large portion of these vineyards are planted on gravelly upland adobe soil, and so notable a departure from the usual choice of lighter soils for the vine makes the character of the Mission lands of considerable interest. Professor Hilgard reports as follows:—

Samples were taken from the upland adobe of the neighborhood, now mostly occupied by vineyards, and of the deep black calcareous soil which is found in the smaller valleys southward, and which is much lighter in tillage than the upland adobe. The analysis shows the supplies of potash and phosphoric acid in the upland adobe to be ample, the latter being more than twice as high as the average of the lighter soils of the Coast Range opposite, or of the Livermore Valley, as given above. But for so heavy a soil the supply of lime is not as high as would be desirable for easy tillage or even thriftiness to the full extent of which the soil is capable; nor is the supply of humus nearly as large as it should be. In both respects, therefore, the soil is capable of improvement, by liming and green manuring. The partial examination of the deep black adobe of the valleys, for comparison in the latter two points, showed the effect of the addition of lime and vegetable matter to the gray adobe of the ridge. The amount of available phosphoric acid is more than doubled, and the surprising growth made by young seedling vines in this soil, as compared with the ridge soil, speaks of the difference in favor of the former.

THE SANTA CLARA VALLEY.—The Santa Clara Valley has a great variety of soils, from the deep rich blackish loams of the Alviso District, which are largely used for vegetables and small fruits, southward to the lighter loams and the sedimentary deposits which constitute the famed fruit lands around San Jose and Santa Clara. The higher portions of the valley slope are often gravelly, and above them are the shallower but very desirable loams of the hill-sides which inclose the valley. The desirability of the best valley lands has been so well and so long tested by practical culture that investigation has rather been given to the uplands and hill-sides, which have more recently been planted with fruit.

Professor Hilgard has specially examined samples of dark gravelly loam representing the extreme western edge of the sloping, gently rolling plain that forms the western portion of the Santa Clara Valley southward of Mountain View. Along the streams the soil is of great depth, sometimes showing hardly a perceptible change for twelve or fifteen feet in depth, and the

roots of trees are found penetrating freely to such depths in the gravelly material. In his report Professor Hilgard says:—

This great depth, perviousness, and perfect drainage would constitute, alone, no mean advantage, if the soil were only of moderate fertility. But the analyses show a very high supply of plant food, surprisingly so in view of the rather markedly low percentages found on the ranges near Searsville. The dark, gravelly soil here in question is a very rich one in every respect. The potash and lime percentages are unusually high, as is also the supply of humus; that of phosphoric acid is high, and in an available condition. In the subsoil this ingredient is in smaller but still very fair supply. Under the circumstances the large humus percentage is an earnest of a large supply of nitrogen also. It is true that these large percentages apply only to one-half of the soil mass, the rest being gravel. But the depth and easy permeability of the soil more than make up for the difference, in comparison, *e. g.*, with an adobe soil of similar composition. These soils may be considered as well adapted to the production of almost any fruit consistent with the local climate, and should yield heavy-bodied, spirituous wines.

The university vineyard plot at Cupertino is situated on a gentle slope which lies between the Santa Clara Valley proper and the Coast Range. The soil is a drab-tinted clay loam, largely intermixed with gravel and rock fragments, being in general of the character just described.

Large tracts of the red "chamisal" and "chaparral' land on the hill-sides of the Santa Clara Valley have been cleared for fruit during the last few years. Of a specimen of such soil, from two miles northeast of Saratoga, Professor Hilgard says:—

The analysis gives high testimony to the intrinsic value of this soil. It has an abundant supply of potash as well as of lime, even for such a heavy soil. Its phosphoric acid percentage is fair; its supply of humus, somewhat extraordinary for a soil formed in an "arid" climate. Its power for absorbing moisture is very high, from the concurrence of the large humus supply with that of iron oxide. It is, therefore, a soil of great resources, and well deserving of the high culture which its peculiar mechanical condition necessitates. It must be kept thoroughly and deeply tilled, and its somewhat refractory subsoil should be broken up so as to allow roots deep penetration. The soil is a heavy clay, dark reddish brown when dry, and forming hard lumps; dark umber color when wet, and softening easily; quite stiff in working, but assuming good tilth when taken at the right stage of moisture.

SANTA CRUZ AND SOUTHWARD.—Though much of the soil just described exists on the east or landward side, there is on the seaward slope of the Santa Cruz Range an evident predominance of light loams on which much fruit is now being planted. A sample of such soil from Soquel, which was analyzed by Professor Hilgard, showed rather a small percentage of potash and phosphoric acid. Their lime supply is still, however, quite adequate for thriftiness in such light soils, which, like those farther south, show a very satisfactory and remarkably uniform power for absorbing moisture. It is evident that the phosphates will be the first thing requiring replacement when these soils become "tired," and fruit rather than grain culture should be pursued by those cultivating them.

One sample of the coast loams was from redwood land taken about two hundred feet above sea level and two miles inland from Pescadero. As much fruit is now grown on land cleared from the redwoods, it is of interest to state that the analysis shows a high percentage of lime, a large one of potash, and a considerable higher amount of phosphoric acid than the soil from Santa Cruz just mentioned, but still somewhat low. While sufficient for thriftiness in the presence of so much lime, it is pretty certain to need phosphates so soon as its first fertility is exhausted. The humus percentage is remarkably high for so light a soil within the coast region. It probably represents fairly the favorite soil of the redwood.

The Pajaro Valley is a region of various soils. Lowest are the clayey loams of the bottom, on which the growth of small fruit has extended vastly during the last few years. Above are stretches of adobe, and higher still are dark reddish loam plains bounded by slopes; on these higher loams and hill-sides there are thrifty orchards.

Eastward are the Gilroy and Hollister regions, being southern extensions of the great Santa Clara Valley. They contain a variety of soils, from deep moist alluviums to warm, red, hillside loams; and these are fast being employed for fruits according to their different adaptations.

The upper and higher portions of the Salinas Valley and its tributaries, the Huer-huero and Estrella, form an extensive plain dotted with oaks and having mostly a light loam or even sandy soil, of great depth; there are also limited tracts of clay or adobe, but the lighter soils alone have thus far been used for fruit, and few of the trees are old enough to do more than indicate the eminent adaptability of the soil and climate to fruit growing. The soils in general are highly calcareous and rich in potash, and in some cases show an extraordinary supply of phosphates. This is a newly-developed region, in which actual experience is of recent date.

The Arroyo Grande region, which is the garden ground of San Luis Obispo County, has deep rich loams, easily tilled and retentive of moisture. Some fruits, apples, perhaps, in particular, are grown in great excellence.

THE SOILS OF SOUTHERN CALIFORNIA.

Professor Hilgard's examination of the soils of this popular portion of the State shows them to be for the most part of exceptional fertility. He has kindly prepared for this work a condensed statement. A fuller review, with analyses and other data, will appear in a University publication now (1891) in course of preparation.

The main features of the soils prevailing in the valley of South California, from Redlands at its head to Los Angeles at its opening out toward the sea, may be thus stated: The San Bernardino Range, or Sierra Madre, has contributed to the deposits in the main valley enormous masses, chiefly of granitic sand, which at some points on the slopes forms the soils exclusively, but everywhere constitutes a prominent ingredient of the valley and mesa lands. Along the base of the Sierra Madre the valley is bordered by a high bench or terrace, readily traced from the head of the valley to San Gabriel, and, on the opposite side, from San Timoteo Cañon around to Riverside, South Riverside, and Rincon. These terrace lands are conspicuous for their orange-red tint, and the red sandy loam of which they are composed, to depths varying from ten to as much as eighty feet, is evidently the choice soil for orange culture. It is manifest that at some remote epoch it filled the entire valley. Of the middle portion much has been washed away, but islands of it form red-land tracts of greater or less extent all over the region, traversed by, and more or less commingled with, the granitic wash from the valleys and cañons of the Sierra Madre. The latter frequently consists largely of gravel, and were it not for the luxuriant natural vegetation borne by these gravel beds, few would have thought of devoting them to the costly experiment of orange planting, which, nevertheless, has proved eminently successful even on these unpromising-looking masses of *débris*. In the upper valley (San Bernardino Valley proper) the red loam is conspicuous, and gives its name to the flourishing settlement of Redlands, on the terminal slope; but the heavy flow of water from the upper cañons, notably from that of the Santa Ana River, has scoured it out of the valley itself, and left there, at least on the northern portion, gray and blackish granitic loams of great depth and productiveness, underlaid, and therefore underdrained, by the enormous gravel beds that hold the artesian water of this favored region. Where this water approaches or rises to the surface, there are formed the "cienegas," or moist lands, having a fine-textured, usually blackish and more or less heavy loam soil, profusely fertile (too much so for fruit culture), and mostly devoted to the growing of vegetables. From these cienegas there frequently flow natural springs, and artesian water is very commonly obtained by boring. They are generally marked by the growth of sycamores or willows, and sometimes by a dense and luxuriant thicket of grass and tule. Small cienegas of this character are found, *e. g.*, near the towns of San Bernardino and Pomona. A very large tract of moist land forms the central portion of the Chino Ranch,

while around lie the reddish and gray loams, adapted to fruit culture with the aid of irrigation. Similar grayish loams were among the first lands to be planted in oranges at Riverside, as they lie below the Warm Creek ditch. Those now being planted are chiefly the higher lying, "red mesa" lands, irrigable only from the upper ditches. Similar reddish loams, partly sandy, partly gravelly, constitute the greater portion of the slope lands of the South Riverside and Auburndale colonies, and cover much of the mesa and hill lands that form the southern portion of the Chino Ranch.

The mesa and valley lands within the drainage basin of the San Gabriel River, forming the northwestern or lower part of the main valley, are somewhat more generalized, by a uniform intermixture of the granitic sand of the Sierra with the red loam of the upper valley. The soils of the hill country between Pasadena and Los Angeles City, and the higher bench lands of San Gabriel, are quite sandy and gravelly, as are also the lower lands derived directly from the wash of the rivers; but there are certain benches, as the "Alhambra Tract," near San Gabriel, having a somewhat heavier, and of course more durable, soil.

Chemically these upland soils may all be said to contain an abundance of lime and potash, phosphoric acid fairly high in the reddish bench lands below the head of the valley, and quite high in the naturally moist lands, while in nearly all, except the latter, humus, and therefore nitrogen, is quite low, and will doubtless be the first substance to call for replacement by fertilizers. Phosphates will come next, and many cases have already been used with profit, while potash, both because of the large supply in the soils themselves, and what is brought on them by the irrigation waters, will not require to be supplied for some time to come, in some cases probably never.

The reddish mesa soils are extensively represented in San Diego County, where the geological formations are very similar to those of the region above described. Near National City the red soil is quite clayey, resembling that near Redlands. The slopes of the Cajon Valley have reddish loams closely resembling those of Riverside, both in physical character and in composition.

COAST VALLEYS.—The valleys of the seaward slope of the Coast Range have mostly gray, light, and silty, rather than sandy, soils, quite similar in appearance from Ventura to Humboldt County, though differing considerably in composition, those of the southern region being more calcareous, and apparently richer in phosphoric acid.

The valleys of Santa Barbara and Ventura Counties are being rapidly planted with fruit-trees. They have for the most part sandy loams in their lower portions, finer materials higher up, and much adobe in the mountain valleys which drain into them. So far examination has not been made of soils from many localities. The report made by Professor Hilgard on his examination of soils from the Santa Clara Valley in Ventura County is significant from the great amount of fruit now being profitably grown on the soils mentioned:—

> The Santa Clara River Valley, which is very sandy and mostly narrow from its head to Santa Paula, then widens gradually, until within twelve miles of the coast it suddenly expands into the Saticoy Plain, widening to about sixteen miles on reaching the coast. The northern portion is largely an undulating upland with a yellowish loam soil; the southern constitutes a kind of a delta of the Santa Clara River, its soil near the latter being a gray, silty loam, while the bench above has a reddish soil. Both soils show an excellent composition, the valley soil having the advantage of a high percentage of phosphates, while the mountain soil, a little heavier, with a smaller amount of phosphates, has a higher lime percentage and more humus. These soils are especially interesting, being peculiarly favored in regard to their relations to moisture. The valley soil remains moist within fifteen to twenty inches of the surface during the driest part of the season, when the water table falls as low as twenty feet. The same is true more or less of the Saticoy Plain at large; and the soil of other valleys, as, *e. g.*, the Ojai, is measurably similar. So are, probably, the valley soils of Santa Barbara, so far as I have the opportunity of examination.

COAST FLATS.—Where the surface descends gradually to the seashore, and not in bluffs of mere soil, there are, as in the Westminster and Anaheim region, coast flats several miles in width, where the soil is a dark-colored sandy loam, glistening with scales of mica, and more or less affected with alkali in the lower portions. Similar soils are found in tracts of greater or less extent up the coast as far as Santa Barbara at least. None of these soils have as yet been analyzed, except with respect to the alkali salts sometimes present in them, which are at times purely saline, at others strongly alkaline from the presence of carbonate of soda, when the use of gypsum affords prompt relief.* As a rule, these seashore lands are very productive, but fruits for them must be chosen with reference to their low level and exposure to coast influences.

DESERT SOILS.—In view of the extension of fruit culture upon the so-called desert lands of the Mojave and the valley of the Colorado, wherever irrigation can be secured, it is important to include a note on these soils to show that, to some extent, at least, these lands are deserts because of lack of water and not because of infertility of soil. Professor Hilgard gives these sketches:—

* "*Vide* Report on Alkali Soils," etc., by E. W. Hilgard, Berkeley, Cal. A copy can be had free on application.

The analysis of the soil from the neighborhood of Mojave shows clearly that it is not inferior in productive capacity to some of the best soils of the great valley, which it greatly resembles, save in the scarcity of humus, or vegetable matter. Its supply of lime and potash is high; that of phosphoric acid low, but not more so than in some very productive soils of the valley. The scarcity of humus is the defect which it would be most needful to remedy; probably best by turning in a crop of alfalfa, which there could be no difficulty in growing where irrigation is available. There are doubtless many tracts where even this defect does not exist, since they are covered with a dense growth of small shrubs, under which grasses flourish in good seasons, giving pasture to sheep. Irrigation is here the all-important question, since the natural rainfall of about four inches, sometimes reduced to one or two, cannot be relied upon for any purpose. Only a detailed survey, however, can determine the tracts having an arable soil, as against those overrun by arid sand.

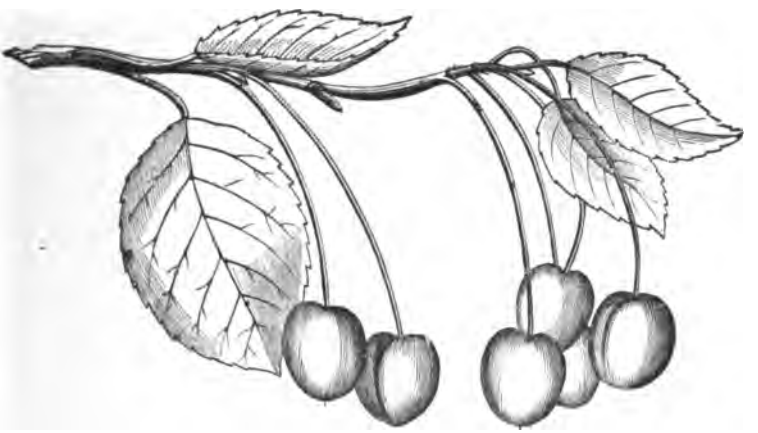
The soil of the Colorado River bottom is certainly a highly productive one, easily worked, and not liable to suffer from wet in case of overflows, being quite light, notwithstanding its large percentage of alumina, as shown by analysis. It is a highly calcareous soil, containing over sixteen per cent of carbonate of lime, partly in concretions, but mostly in a finely pulverulent form. Its potash percentage is very high, yet there seems to be no trouble from alkali, as the soda percentage is quite small. Its supply of phosphoric acid is fair, though not large for a bottom soil; the humus percentage is likewise small for a lowland soil, yet adequate. It is therefore likely that whenever the water of the Colorado River shall be made available for irrigation, these bottom-lands will yield rich returns for cultivation.

It has been demonstrated that some situations in what is called the desert region are fitted to produce very early fruits, and probably there are locations where such fruits as the date will yield better results than in other portions of the State. Quite a beginning has already been made in the development of these desert lands.

CHAPTER IV.

THE WILD FRUITS OF CALIFORNIA.

AMONG fruits native to California, the apple, because of its acknowledged kingship of fruits borne on deciduous trees, may be mentioned first. On the banks of streams from Sonoma County northward, beyond the boundaries of the State, is found



NATIVE CRAB APPLE OF CALIFORNIA.

the "Oregon crab apple" (*Pirus rivularis*), described as a shrub or small tree, but which, in favorable situations, attains good size. Such trees are reported from the neighborhood of Crescent City, Del Norte County, with bodies one foot in diameter, with spreading tops, loaded with small, oval fruit, of a golden color when ripe.* This fruit is eaten by the Indians, and was used in early times for jelly making by the white settlers. The tree is generally found on cold, wet land, bordering ponds, streams, and marshes.

The California wild plum (*Prunus subcordata*) has attracted considerable attention ever since the advent of the gold seekers. It was early noticed that there are at least two varieties† of the

* John Mavity, in *Pacific Rural Press*, Vol. IV, p. 198.
† A Kellogg, in *Hutching's Magazine*, Vol. 5, p. 8.

species. They are found well distributed over the uplands of the coast and interior, becoming, however, more abundant, and bearing more pulpy fruit, toward the northern part of the State. One variety (*Kelloggii*) is round, yellow, and sometimes nearly an inch in diameter; the bush is also larger; the other, a little smaller, oblong, and almost the shape and color of a Damson when ripe. The fruit is borne upon scraggy, many-branched shrubs, from three to ten feet high, which generally grow in patches at the head of ravines, on rocky hills, and in open woods. The two varieties are found associated, and both are esteemed by Indians and whites.

Early efforts were made to domesticate these wild plums, and they showed themselves susceptible of improvement by cultivation to a certain extent. In 1856 there was, on the Middle Yuba River, not far from Forest City, in Sierra County, a wayside establishment known as "Plum Valley Ranch," so called from the great quantity of wild plums growing on and about the place. The plum by cultivation gave a more vigorous growth and larger fruit.* Transplanted from the mountains into the valley they are found to ripen earlier.† Transplanted from the mountains to a farm near the coast, in Del Norte County, they did not thrive.‡ One variety, moved from the hills near Petaluma, in 1858, was grown as an orchard tree for fifteen years, and improved both in growth and quality of fruit by cultivation.§ The attention of fruit growers was early drawn to the possible value of the wild plum as grafting stock, and it is reported to have done fairly well on trial.‡‡ Recently excellent results have been reported from the domestication of the native plum in Nevada County, and fruit shown at the State fair of 1888 gave assurance that by cultivation and by selecting seedlings valuable varieties can be obtained. It is stated‖ that in Sierra County the wild plum is the only plum which finds a market at good prices, and that cultivated gages, blue and egg plums scarcely pay for gathering. The wild plum makes delicious preserves.

NATIVE PLUM OF CALIFORNIA.

* Report California Agricultural Society, 1858, p. 183.
† *Cal. Culturist*, 1858, p. 242.
‡ *Pacific Rural Press*, Vol. IV, p. 198.
§ The same, p. 163.
‖ Letter from S. B. Davidson, Downieville.

Classed also among the plums is the "oso berry," or, as it is sometimes called, the "California false plum" (*Nuttalia cerasiformis*), a shrub or small tree, from two to fifteen feet in height, found in moist places and on the north slopes of hills, from San Luis Obispo northward. It has bark smooth and brown like a plum or cherry. The fruit when ripe is clothed with a handsome blue bloom, and is an oblong, plum-like, pulpy fruit, beautiful, but rather bitter. This species has also been used as grafting stock, with the effect of dwarfing and causing early bearing* of the varieties worked upon it.

We have several species of *Cerasus*, which may be called wild cherries. The first is commonly called the wild or chokecherry (*Cerasus demissa*) and is an erect, slender shrub, two to twelve feet high, bearing on a raceme a round, purplish-black or red fruit, with a round stone. The fruit is edible, but somewhat astringent. This species occurs throughout the State, except near the coast, extends northward to the Columbia River, and eastward to the Rocky Mountains. This species very closely resembles the chokecherry of the Atlantic States. Some observers, however, protest againt calling it a chokecherry, because it has none of the properties of that cherry, but in the mountains of San Diego County, according to C. R. Orcutt, the fruit very nearly resembles in taste its Eastern relative. The wild fruit is used to some extent for marmalade.† It has been cultivated to some extent in places near its habitat. In 1858 there was quite a plantation of it in the foot-hills east of Marysville.‡ As it grows well on cool north hillsides in the Southern counties, it has been suggested§ that the improved cherries, which are, as a rule, not satisfactory so far as tried in that part of the State, might succeed if planted in the places where the wild cherry thrives; or the wild roots might prove trustworthy and valuable stocks on which to work the improved varieties. They were used for this purpose in Oregon in 1850, because there were no other cherry stocks available. An excellent growth of graft was secured, but the stock was condemned because of suckering.‖

There is another species (*Cerasus emarginata*), which sometimes becomes a tree twenty-five feet high, bearing fruit in an umbel or true cherry fashion. The fruit is roundish and black, and about one-third of an inch in diameter, very bitter and astringent. From its bearing habit it has been suggested as worth trial as a stock for improved cherries. The habitat of this spe-

* *Pacific Rural Press*, Vol. IV, p. 198.
† J. G. Lemmon, in *Rural Press*, Feb. 22, 1879.
‡ Agricultural Society Report, 1858, p. 174.
§ *Rural Californian*, Vol. X, p. 107.
‖ Seth Lewelling, in *N. W. Horticulturist*, November, 1887.

cies is northern, from Oregon only into the northern counties of California. Another species common on the California Coast Range and Sierra Nevada is *Cerasus Californica.* It is a bush and never a tree. The fruit is lighter red and more intensely bitter than the other species.

The California "evergreen cherry," or *islay* (*Cerasus ilicifolia*), early attracted attention for the beauty of its shining dark green foliage, which somewhat resembles holly. The fruit was shown at the first horticultural fair in San Francisco, in 1853, and was described as of delicate flavor, with a kernel "almost equal in flavor to the almond."* The plant is now grown as an ornamental shrub and as a hedge plant.

There is on the islands of Catalina and Santa Cruz, off the coast of Southern California, an evergreen cherry which is merely a variety (*integrifolia*) of the species on the mainland. It is described† as a tree fifteen to twenty-five feet high, with compact and well-rounded head, bearing a fruit three-quarters of an inch in diameter, dark red purple, the thin pulp sweet, with a bitter almond flavor, but no acidity or astringency. This fruit has been mentioned as worthy of cultivation.‡

Of wild grapes the prevailing species (*Vitis Californica*) has of late become well known through its use as a grafting stock for the European varieties which are grown in our vineyards. Thus far the native species has proved resistant to the phylloxera, and otherwise fitted to work less hardy varieties upon. Something has also been done in improving the species by cultivation and by selection of varieties, and General Bidwell, of Chico, reports the existence of a white-fruited variety. The California wild vine occurs along streams from Lower California northward to the upper part of the State. It is also thought that the species (*Arizonica*, occurring in Arizona and Utah may have intruded into the southeastern portion of California. It has been quite widely introduced as a resistant vine, and seems to share the resistant qualities of the California species.

The list of berries native to California is quite large. As raspberries we have the "thimbleberry" (*Rubus parviflorus*), which has for its area most of the western half of the continent. The fruit is hemispherical, scarlet when ripe, sweet and pleasant flavored. It is found only in the mountains of the interior or easterly parts of the State. A variety (*velutinus*) occurs along the banks of streams on the seaboard, but the fruit is dry and insipid.§

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* *Alta*, Oct. 7, 1853.
† "Studies in Botany of California," by E. L. Greene, Vol. VI, p. 396.
‡ Gustav Eisen, in *Pacific Rural Press*, Vol. XXVI, p. 8.
§ *Flora Franciscana*, E. L. Greene, I, 70.

Another species is the famous "salmon berry" (*R. spectabilis*), bearing a large, ovoid red or yellow glabrous fruit. It is a stoutish bush five to ten feet high. The variety (*Menziesii*) occurs in moist woods or on wooded banks of streams, mostly near the sea, in the northern coast counties of California.* Efforts to introduce the salmon berry as a commercial fruit generally throughout the State have failed. It is a very delicious fruit and highly esteemed in the regions to which it is native.

There is also the wild raspberry (*R. leucodermis*), abundant in the Coast Range and in the Sierra Nevada. It has a yellowish-red fruit, rather large, with a white bloom, and agreeable flavor. Botanically it is very near the black raspberry of the Eastern States, from which it is hardly distinguished by rather more coarsely-toothed leaflets, stouter and more hooked prickles, and the color of the fruit. Wild raspberry patches of considerable area are found in the Coast Range of the upper half of the State. The fruit is gathered by neighboring settlers, and efforts are now in progress for the introduction of the plants in cultivated grounds.

The most delicious wild fruit of California, and at the same time the most important commercially, is the blackberry. We have one very variable species (*R. vitifolius*), bearing an oblong, very sweet, and desirable fruit. It was favorably mentioned by early explorers, was highly esteemed by the Indians, and still plays an important part in domestic economy. It ranges in the foot-hills and mountains from Mexico northward to Frazer River, but at the southward produces its fruit very sparingly. It is often called the dewberry. A variety of this species has attained some fame as a "white blackberry." It is said that about 1860 parties gathering blackberries about half a mile from Crescent City, Del Norte County, discovered a few bushes or vines loaded with a berry exactly in shape of the blackberry, but of a white or cream color. The whole patch did not extend beyond a space of a dozen feet square, but the vines were luxuriant and bore well. It was a great curiosity, and the place and the berry much sought for. Since that time the vines have spread gradually over a space of perhaps half an acre of ground.

Plants have been taken from this locality to different parts.† Our wild blackberry has been planted to some extent, and several varieties have been secured by selection and cultivation. The most famous is the Aughinbaugh blackberry, propagated and sold by a man of that name, about 1875. It achieved some popularity, but, being a pistillate variety, needed association

* *Flora Franciscana*, E. L. Greene, I, 70.
† *Pacific Rural Press*, Sept. 8, 1888.

with other berries to fertilize it.* For this and other reasons it became unpopular, and has been nearly lost sight of.

The wild blackberry quickly takes possession of ground from which timber has been cut. The bushes vary much from year to year in productiveness.

There are four species of strawberry indigenous in California, but two of them are identical with those of the Atlantic States and Europe (*Fragaria Virginiana* and *vesca*). One species we share with Chile (*F. Chilensis*), and the fourth (*F. Californica*) appears to be distinct from foreign and other Californian forms. It occurs from San Diego northward to the central part of the State in the hills of the Coast and Contra Costa Ranges. All these species are gathered for domestic uses. The Chilean species, which grows near the sea, is so abundant in some places that residents trust to the beach for their strawberry supply, and even turn their hogs out to feed upon them.

Currants and gooseberries are represented in our flora by many species. Of the former there is one with a black berry (*Ribes bracteosum*) one-third of an inch in diameter, having something the flavor of the cultivated black currant; another has a reddish, sweetish berry (*R. cereum*); still another (*R. tenniflorum*), bearing a yellow fruit, is used in the mountain districts of the extreme north of the State and described as a fine fruit when ripe. Others are destitute of edible qualities, but have been distributed abroad for their handsome, fragrant flowers.

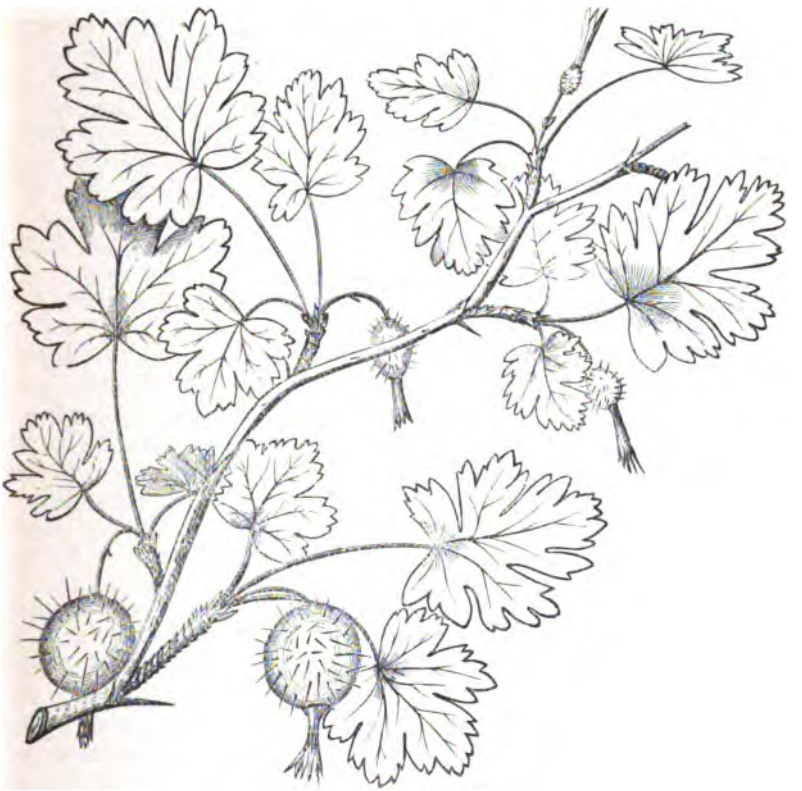
We are well supplied with gooseberry species; one (*R. Menziesii*) has large but rather dry berries. Two of them bear acceptable fruit (*R. divaricatum and oxycanthoides*), the berries being small to medium size, with pleasant flavor. The range of these species is, in the first case, on shady banks and from Santa Barbara northward beyond the limits of the State; and the other species prevails in the Sierra Nevada, from Mariposa northward, at an elevation of six thousand to nine thousand feet; also northward and eastward to the Rocky Mountains and beyond.

Another species, *R. quercetorum* (Greene), is a common wild gooseberry in the counties of San Luis Obispo and Kern. The profusion of small yellow flowers attracts the bees. The fruit, though of only medium size, is destitute of the prickles which cover most California gooseberries, and is of a pleasant flavor, much like that of the domestic fruit.

Several cranberries, or bilberries, are also found within our borders. One (*Vaccinium parviflorum*) bearing pale red, insipid

* *Idem*, December, 1876.

berries is found in the redwoods of Mendocino County, and extends northward to Sitka. Another (*V. ovalifolium*), a more straggling shrub, with large edible, blue berries, extends below our northern border from Oregon, where it is abundant. Another (*V. microphyllum*), with light red berries, inferior to the



WILD GOOSEBERRY OF CALIFORNIA.

European bilberry, is found in wet places in the Sierra Nevadas, at 7,000 feet elevation. Another (*V. occidentale*), also high up in the Sierras, has a small blue berry, covered with bloom, and of sweetish flavor. Another (*V. ovatum*) is an evergreen shrub, erect, bears a dark purple, edible berry, turning black without bloom, and occurs along the Coast Range and vicinity, from Monterey to Oregon, especially in the redwoods.

The manzanita (*Arctostaphylos manzanita*) is botanically a near relative of the cranberry, and is common from Mexico to

Oregon, through the foot-hills and mountains, in dry, rocky soil. The fruit is of a dull red, mealy, and pleasantly subacid, well named by the Mexicans the "little apple" (*manzanita*). The Indians gather the fruit in September, in great quantities, for food, and it is eaten freely by animals and birds. The bearberry (*A uva ursi*) is more northern in its distribution, extending around the world, and is a prostrate or creeping shrub. Early explorers on the coast regaled themselves in the fruit, which is eaten by Indians, and is credited with medicinal virtues. Another species (*A. tomentosa?*) grows along the coast from Santa Barbara northward, producing a smooth, reddish fruit, from which a cooling subacid drink is made. There are numerous other varieties of manzanitas, all producing more or less similar edible berries. They are all small, straggly evergreen shrubs, the manzanita rarely becoming a small tree, graceful in their own peculiar way, and bearing, in earliest springtime, a profusion of lovely white blossoms, sometimes blushing a rosy red in a snow-storm.*

Another botanical associate of the foregoing is the evergreen or salal, a relative of the wintergreen of the Atlantic States. We have two species. One (*Gaultheria myrsinites*), occurring in forests in the upper part of the State, bears a scarlet fruit which is described as aromatic and delicious. The other (*G. shallon*) is the shallon or salal, a purple fruit becoming black, which is highly esteemed by the Indians. This species occurs from the Bay of Monterey northward.

We have also local species of the barberry. One of these (*Berberis aquifolium*) is sometimes called the false Oregon grape. It extends southward into California as far as Monterey. Another species (*B. nervosa*) has much the same range and bears a larger fruit. The fruit of both species is roundish, of acid taste, and is said to be fine for pies and tarts. Still another species (*B. pinnata*) takes a more southerly range, occurring from San Francisco southward into Mexico. The fruit is about one-third of an inch in diameter, pleasant to the taste, and is the *Lenya Amarilla* of the Mexicans.

We have also local species of the service-berry, or Juneberry. One (*Amelanchier alvifolia*) is a shrub from three to eight feet high, occurring from the sea level to an altitude of ten thousand feet. In the Sierra Nevada the fruit is from a quarter to a third of an inch in diameter, purplish and edible.

Other species are *A. glabra*, found in the Sierra Nevada, and *A. pallida*, common on dry hills in the northern and northeastern parts of the State.†

C. R. Orcutt (original).
†*Flora Franciscana*, I, 52.

The lemon-berry (*Rhus integrifolia*) is a stout evergreen shrub, growing along the coast from Santa Barbara south into Mexico. It is frequently but a foot or two in height, but in some localities (on Santa Cruz Island* and in Lower California†) it attains tree-like proportions, and is frequently called mahogany, on account of the rich coloring of the wood. The leaves and bark are considered valuable for tannin. A specimen log furnished the American Museum of Natural History, Central Park, New York, measured nearly two feet in diameter, and a five-foot section weighed one thousand pounds. Another trunk of a tree was measured in the field, being four feet in diameter and of equal height. The deep reddish berries are extremely sour, and coated with a white oily substance even more tart, which eventually crystallizes over the fruit. The berries are credited with medicinal virtues, and are frequently gathered and used in the preparation of a cooling, refreshing drink, equal to lemonade. The Mexicans formerly gathered the berries, and dried or roasted and ground them like coffee berries, for use in making a drink when fresh fruit was not available.‡

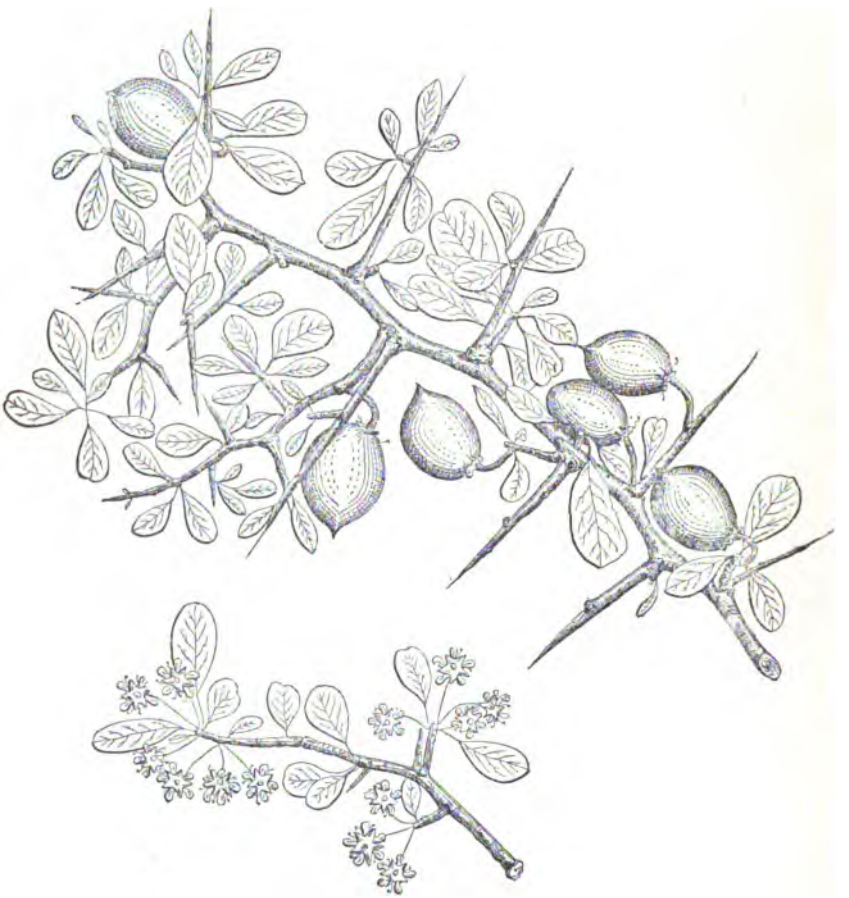
The sugar tree (*R. ovata*) is a nearly related shrub or small tree, producing smaller berries, equally tart and useful for preparing a lemonade, but with an additional advantage in that it furnishes the sugar as well as the acid principle for this pleasing drink. The white coating, instead of being sour, is sweet; when dry of the consistency of bees'-wax, and was formerly gathered in quantity by the Indians, whose fondness for sweets is well known. The first-named tree is confined to the coast regions, the last belonging more properly to the mountain and desert regions.§

The fruit of the "squaw bush" (*R. trilobata*) is pleasantly acid and very refreshing. It is eaten by the Indians, who also use the slender twigs in their choicest basket work. It is found throughout the whole length of the State.

The California toyon (*Heteromeles arbutifolia*) is a handsome evergreen shrub found throughout the State, better known as the Christmas berry or California holly. The scarlet berries are borne in the greatest profusion, and, ripening at Christmas-time, are extensively used in decorating. The berries are said to have formed an important article of food with the Indians, and school-children frequently eat them; but, so far as known, they are not otherwise utilized. They are not unpleasant to

*E. L. Greene, "Studies," No. VI.
†C. R. Orcutt.
‡*West American Scientist*, III, 45.
§*Loc. cit.*, 46.

the palate, having a healthy bitterish by-taste. The toyon is more useful as a hedge plant, doubtless, than it is valuable for its fruit. It ranks high as an ornamental evergreen, and is given in catalogues under the name of *Photinia arbutifolia.* At Los Angeles, and elsewhere in the State, it is found in cultivation, and highly prized for its beauty.*



THE CALIFORNIA JUJUBE.

California has a native species of a genus which includes the classic lotus and the jujubes so well known as the source of jellies and confections of various kinds. It is known as Parry's lotus or jujube (*Zizyphus Parryi*), and is found in gravelly ra-

*C. R. Orcutt.

vines near San Felipe and Rock Summit House, in San Diego County; also in like situations east of San Bernardino. It is a zigzag-branching, thorny bush or small tree, four to sixteen feet high, seldom over four to six inches in diameter. The accompanying sketch shows its thorny wood, foliage, blossoms, and fruit. The fruit is one-half to three-fourths of an inch long, has one to three seeds, and is mealy and dry. The character of the plant suggests its adaptation to hedge purposes, and possibly its choice of location may indicate the proper field for experiment with foreign jujubes, the fruit of which may be superior. Such species have already been distributed in the State to some extent.

First in importance among the native nuts of California is the California black walnut (*Juglans Californica*). The tree attains a height of twenty to seventy-five feet, with a diameter of trunk of two to four feet. It is more graceful than the grosser English walnut, not so heavy as the great black walnut of the West, nor so open, light and airy as the white walnut or butternut of the Eastern States. The nut is roundish, somewhat variable in size, much smoother than the Eastern black walnut, and the kernel is sweeter and of more delicate flavor. The tree prefers deep, moist soils, and is usually found along creeks. Its range is from the central zone of the State southward to San Diego and from there eastward through Southern Arizona into New Mexico and Sonora. The nuts, though excellent, are not of great commercial account. The tree is a popular shade and avenue tree and the root succeeds admirably as a stock for the English walnut.

Perhaps the most interesting wild nut of California is the wild almond (*Amygdalus Andersonii*), which is found on the eastern slopes of the Sierra Nevada Mountains. It is a low, spreading shrub, one to six feet high. The fruit, though diminutive, bears all the essential characteristics of the almond. The dwarf habit of the species suggests experiment with it as a stock for dwarfing peach trees.

The filbert of the Pacific Coast (*Corylus rostrata*) is mentioned chiefly because of its relationship to the Eastern and European species, which have yielded improved varieties of great commercial value. Our species is a shrub from four to twelve feet high and two to six inches in diameter. It is of flexile and arching habit, suckers, and spreads in moist coast regions, amid half shady woods. Its leaf, bloom, and fruit are shown in the accompanying sketch. The nut is oblong, tightly inclosed in a green husk lengthened into a snout or beak, like a narrow-necked flask, jagged and ruffled at the lip. The bunches that

grow on the ends of the twigs seldom perfect more than two or three nuts of inferior size and quality.* Our wild species has frequently been mentioned as indicating in its choice of habitat situations suitable for the better filberts, hazel or cob nuts, and as probably offering stock suitable for grafting on the better kinds, but the practicability or value of the suggestion has not yet been demonstrated.

THE CALIFORNIA FILBERT.

Our nearest approach to a chestnut is the Western chinquapin (*Castanopsis chrysophylla*), which occurs from Oregon to Monterey, and in the Sierra Nevada to an altitude of six thousand feet. In the northern coast counties it becomes a grand tree from fifty to one hundred and twenty-five feet in height, but the most prevalent form is the variety (var. *minor*) which is a shrub of two to six feet, and bears abundantly a sweet nut with a hard shell like the hazelnut, which it also resembles somewhat in shape, but is rather more pointed.*

Two classes of nuts claim mention because of their importance as an article of diet with the aboriginal population. First are the pine nuts, edible seeds of sev-

* Kellogg's "Forest Trees of California."

eral species of pine.* These nuts are said to be a very concentrated and sustaining food. They are ground and made into "piñon pone," which is described as very nutty, rich, and delicious, but if fed upon too exclusively the great excess of oil produces boils and the like.† Pine nuts are, to a certain extent, an article of commerce, and are found in the California fruit and nut markets.

The Indians also use acorns of several species of oak in their bread-making. In the California Desert borders there is a shrub oak (*Quercus turbinella*, Greene) growing to a height of two to eight feet, which bears sweet and edible acorns. This species, however, ranges eastward into Arizona and not in the main regions of California. The acorns used by the Indians are usually bitter when they first fall from the trees, but later on they sweeten. Continuous rains and melting snows extract the bitter and injurious principle and leave the farinaceous and starchy. The Indian hastens the process by beating off the shells and leaving the kernels to leach in excavations made in the sand or on mounds of sand, or, if the rains delay too long, he soaks the acorns in the running water of the streamlet. The Indians store large quantities of acorns for future use. The woodpecker places the acorns in holes in the bark, point inward, so that the water running down the tree laves the porous base of the nut and thus extracts the bitterness.†

In Southern and Lower California there grows a low, oval-formed, rigid shrub (*Simmondsia Californica*) which produces an acorn-like fruit, edible and pleasant to the taste, called the "goat nut." The Indians at the Santa Catalina Mission, in Lower California, claim not to eat them, and there is no record available as to whether other Indians ever utilized them for food. The bush bears profusely, grows under all conditions of soil and climate that exist on the coast, mountain and desert regions of San Diego County‡ and would seem to be worth experimenting with.

From Texas to California is found a variety of trees belonging to the bean family, of which the mezquite (*Prosopis juliflora*) is probably the best known. The mezquite tree makes an excellent hedge. The wood is unsurpassed for fuel, is very hard, heavy and fine-grained, taking a beautiful polish, and is also richly colored. The tree secretes an amber-colored gum possessing the qualities of gum arabic, but the supply is not sufficient to make it an article of commerce. The ripe pod or bean,

* Notably *Pinus monophylla, Coulteri, Sabiniana, Torreyana, Parryana.*
† Kellogg's "Forest Trees of California."
‡ C. R. Orcutt.

with thick and spongy mesocarp, contains a large proportion of sugar and other nutritive principles, and is a valuable article of food. Horses and mules are especially fond of this pod and thrive upon it as a substitute for grain, and with the Mexicans and Indians it forms a staple food. The screw bean (*Prosopis pubescens*) is almost equally as well known and valuable as the mezquite tree.

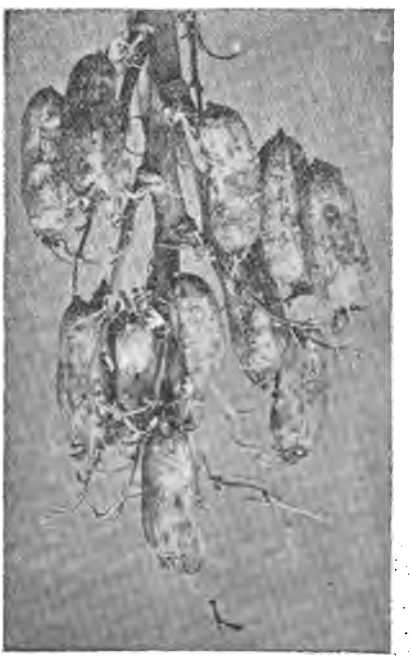
Among the most useful of Southern California native fruits, next to the mesquite bean, ranks the fan palm (*Washingtonia filifera*). The small black berries, borne in great clusters of ten to twenty pounds weight each, furnished the desert Indians with a most important article of food, equal to that of the piñon nuts to the mountain tribes. The fruit has a thin, very sweet and pleasant pulp, which any palate might appreciate. The *Tecos grandes*, or "large nuts" (*Erythea armata*), the fruit of the beautiful blue palm of adjacent portions of Lower California, is a much larger fruit, which also forms an important article of food with the Indians in their season. These, while not of commercial value as fruits, yet point plainly to the adaptability of our desert regions to date culture, a fact already proven by the few experiments in its growth in that little known region called the Colorado Desert. Another wild palm occurs on Guadalupe Island, off the west coast of Lower California, which bears a larger edible fruit or nut, and which thrives well in California. This is *Erythea edulis* of botanists, a most ornamental and useful species.*

FRUIT OF ERYTHEA.

The wild banana (*yucca baccata*) enjoys a multitude of popular names, such as wild dates (the *datile* of the Mexicans), Spanish bayonet, Mexican dagger plant, etc. It is found in Southern California, eastward to Texas and southward in Mexico. As decorative plants the yuccas are justly prized, and none of the numerous varieties outrank this in beauty of flowers

*C. R. Orcutt (original).

and habit. It attains almost tree-like proportions, and forms extensive forest-like plantations. Such a forest, when in full bloom, is a sight to be remembered. The large, waxy, bell-shaped flowers, of a creamy whiteness, sometimes marked with prune purple, are of surpassing beauty. The fruit does not seem to mature well in this State. It is somewhat of the size and shape of a banana (hence its American name), of a sweetish taste, slightly reminding one of a fig.*



THE WILD BANANA.

The "beach strawberry" (*Mesembrianthemum æquilaterale*) is not a strawberry, but a near relative of the ice plant. They are both excellent for salad, and the fruit of the former is a good-sized berry, of a peculiar flavor, very delicious, but very remotely suggesting a strawberry. It is abundant on the seashore, and also occurs in South America, Australia, and Tasmania. The brilliancy of the flowers renders the prostrate plant still more attractive, and a hunt for the luscious berries renders a day on the beach of great interest to children of small and "larger growth" as well. In the Santa Cruz region they are known as "sea apples."

The elder of California (*Sambucus glauca*) is superior to either the Eastern or European species in the quality of its fruit. It is common throughout the State, and frequently becomes a tree twenty feet or more in height, with a trunk eighteen inches in diameter. The fruit is very abundant, and largely used.

The fruit of several species of cactus fruits, which are produced upon plants which have become naturalized from early plantings at the missions, are often regarded as native fruits of California. There are native species bearing edible fruit, but much inferior to the species introduced from Mexico, which will be considered in a subsequent chapter.

*C. R. Orcutt.

CHAPTER V.

CALIFORNIA MISSION FRUITS.

CULTIVATED fruits were first brought into California from the South. Mission work among the Indians of Lower California was actually begun by the establishment of the mission at Loreto by Salvatierra, October 19, 1697. The following years horses and cattle were brought from Mexico, and from this introduction came ultimately the vast herds which roamed the hills and plains of California.* Probably the first seeds and plants of cultivated vegetables and fruits came about the same time, for there was a small garden and a few fruit trees at Loreto in 1701.† But Loreto was not fitted for horticulture, and in the same year an expedition in charge of Father Ugarte, who is called the founder of agriculture in Lower California, crossed over the mountain to a more suitable location at the mission of Vigge Biaundo, which had been destroyed some time before by hostile Indians. Ugarte restored the mission, made irrigating ditches, and planted fruit trees and vines. This effort was successful from a horticultural point of view, for in 1707 Ugarte made more wine than would suffice for mission use, and sent some to Mexico‡ in exchange for other goods. Thus began the export trade in California wine.

The Jesuits continued their establishment of missions in Lower California until there were fifteen missions, at five of which there were vineyards,§ and presumably as many or more which had gardens with fruit trees. It is recorded that in 1728 Father Luyando established the northern mission of San Ignacio, of which was written in 1759: "Exotic plants in that barren land throve well; and others, which were native of it, throve under his culture."‖ Luyando likewise planted vines, olive trees, fig trees, and sugar-canes, all of which seem to have succeeded, and proved of great service to the mission.¶ Fruit culture seems to have early engaged the attention of residents of Lower California, aside from the padres, for accounts of voy-

*Hittell's "History of California," Vol. 1, p. 177.
†*Loc. cit.*, p. 190.
‡"Venegas' California" (1757), Vol. 1, p. 321.
§Bægert, cited by Hittell, Vol. 1, p. 283.
‖Venegas.
¶"Forbes' California" (1839), p. 50.

ages made during the latter part of the last and the beginning of this century contain mention of the delicious fruits bought in the harbors of Lower California, and the pleasant experiences of sailors who strayed inland and visited the valley fruit farms.

The variety of fruits grown in Lower California was small. They had figs, oranges, citrons, pomegranates, plantains, and some olives and dates. There were no North European fruits, with the exception of a few peaches, which, however, did not appear to thrive.

The Jesuits were supplanted in Lower California, in 1768, by the Franciscans. The Franciscans, led by Junipero Serra, at once pressed northward, and entered the territory which is now the State of California. Their first establishment was at San Diego, in 1769. Thence they proceeded northward, braving many perils, and undergoing great hardships, establishing missions through the coast region of the State. Credit is given to the secular head of the expedition to San Diego, Don Joseph de Galvez, representing the king of Spain, for ordering the carrying of seeds of fruits, grains, vegetables, and flowers into the new territory, and from the planting at San Diego the same varieties were taken to the missions afterwards established.*

In all twenty-one missions were established, the last at Sonoma, in 1823. The late John W. Dwinelle, who gave much attention to the history of the missions, said:—

> Gardens, vineyards, and orchards surrounded all the missions, except the three northernmost,—Dolores, San Rafael, and Solano,—the climate of the former being too inhospitable for that purpose, and the two latter, born near the advent of the Mexican revolution, being stifled in their infancy. The other missions, according to their latitude, were ornamented and enriched with plantations of palm trees, bananas, oranges, olives, and figs, with orchards of European fruits, and with vast and fertile vineyards, whose products were equally valuable for sale and exchange, and for the diet and comfort of the inhabitants of the missions.†

KINDS OF FRUIT AT THE MISSIONS.

It is of no little interest to ascertain how great a variety of fruits was grown in these mission orchards. Vancouver, in 1792, found a fine orchard at Santa Clara, with apple, peach, pear, apricot, and fig trees, all thrifty and promising.‡ He also describes at the mission of San Buena Ventura apples, pears, plums, figs, oranges, grapes, peaches, and pomegranates.§ Robinson described the orchards connected with the Mission of San Gabriel as very extensive, having among their trees oranges, citrons, limes, apples, pears, peaches, pomegranates, and figs. There were also grapes in abundance.‖ Edwin Bryant noticed

*"Records of the Founding of Missions," cited in Rep. State Board Hort., 1890, p. 185.
†"Colonial History of San Francisco," p. 44.
‡Vancouver. III, 24, cited in Hittell's "History of California," Vol. 2, p. 474.
§"Fremont's Memoir," p. 14.
‖Hittell, *loc. cit.*

at San Luis Obispo Mission the orange, fig, palm, olive, and grape. At the Mission San Jose he found an inclosure of fifteen or twenty acres, the whole of which was planted with trees and grape-vines. There were six hundred pear trees and a large number of apple and peach trees, all bearing fruit in great abundance and in full perfection. The quality of the pears he found excellent, but the apples and peaches indifferent.* E. S. Capron, in a general enumeration of the fruits grown at the missions, includes cherries.†

It is impossible to arrive at full statistics of the fruit trees and vines in bearing at the period of greatest prosperity at the missions. At the time of the secularization inventories were made of the mission properties. The statement of the Santa Ynez Mission includes nine hundred and eighty-seven fruit trees, valued at one dollar each; San Fernando, one thousand six hundred fruit trees, valued at one dollar and fifty cents each; San Gabriel, two thousand three hundred and thirty-three fruit trees, with no valuation; San Diego, five hundred and seventeen olive trees.‡

EARLY PLANTINGS BY OTHERS THAN THE PADRES.—Though the earlier Spanish population had the example of successful horticulture before them for half a century at the missions, they did not seem inclined to emulate the efforts of the *padres* upon their own grounds, except in occasional instances. Hittell says:—

> Horticulture and gardening were confined almost exclusively to the missions. . . . Hardly a ranchero or a colonist from San Diego to Sonoma planted a fruit tree, and gardening was not attempted except on a very small scale, and only for such vegetables as could be produced with very little labor.§

The exceptions were, however, notable, and deserve mention. General Vallejo planted fruit trees in Sonoma Valley as early as 1830, and of his place it is said: "It is an old and well-cultivated place, well known in all the northern portion of California while this State was still Mexican territory."‖ Exceptions there were, also, at the South. The old fruit garden on the Cumulos rancho, in Ventura County, has become famous. Fremont, writing of his observations in 1846, says:—

> Among the arid, brush-covered hills south of San Diego we found little valleys converted by a single spring into crowded gardens, where pears, peaches, quinces, pomegranates, grapes, olives, and other fruits grew luxuriantly together, the little stream acting upon them like a principle of life. . . . A single vine has been known to yield a barrel of wine, and the olive trees are burdened with the weight of fruit.¶

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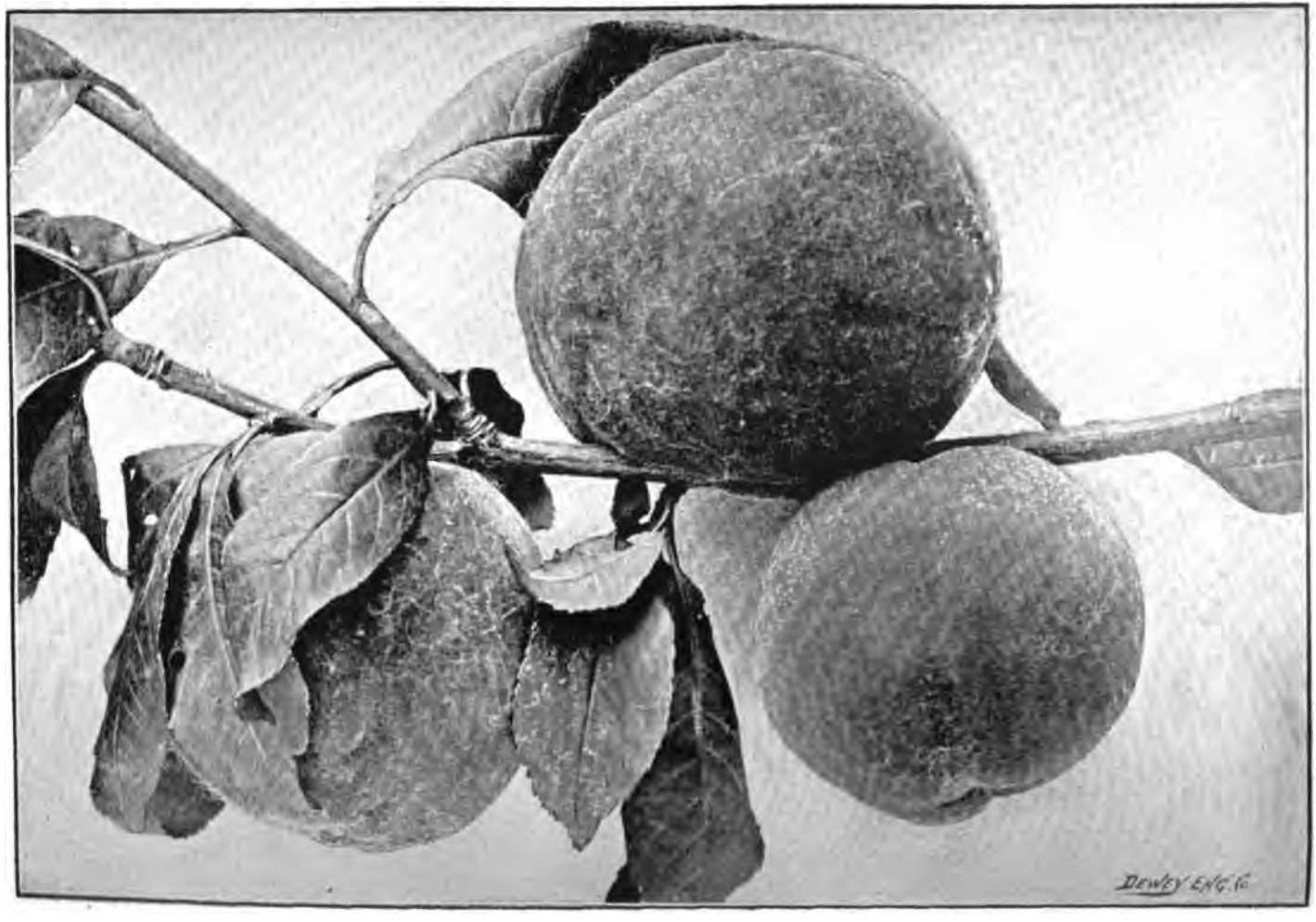
*"What I Saw in California in 1846–'7," p. 376.
†History of California (1854). p. 111.
‡"Bancroft's History of California." Vol. 3, p. 619, *et. seq.*
§Hittell's "History of California," Vol. 2, p. 474.
‖"Report California Agricultural Society." 1858, p. 247.
¶"Geographical Memoir," p. 39.



McKEVITT'S EARLY.

see plate for description in text.

There was at Santa Margarita an excellent vineyard, owned by Pio Pico, the last Mexican governor of California.

It is written* that scarcely had six years elapsed subsequent to the settlement of the pueblo of San Jose on its present site before the inhabitants were enjoying the benefits of luxurious fruits. More was grown than could be disposed of in its natural state. It seems that Don Manuel Higuerra had more peaches than he could use, and, knowing the law, secured the following document from the capital:—

The individual Manuel Higuerra has permission to make as much as one barrel of peach brandy.
Monterey, 10th day of August, 1805. NORIEGA.

DECLINE OF THE MISSION ORCHARDS.—The decline of most of the mission orchards and gardens followed the secularization of the establishments in 1834. There were some exceptions where the mission lands fell into enterprising Spanish or American hands. But as a rule, as Fremont wrote in his observations in 1846, "but little remains of the high and various cultivation which had been attained at the missions. . . . Fertile valleys are overgrown with wild mustard; vineyards and olive orchards decayed and neglected."

During the years of neglect, the more tender trees died, and the more hardy survived. The pear and the olive vied with the vine in withstanding drought and the trampling and browsing of the cattle that roamed unmolested through the deserted gardens. These pears, as will be described presently, were turned to good account by the early American settlers; the olive and the vine furnished cuttings for most of the plantations made during the first twenty years or more of American occupation.

Concerning the old olive trees at the Mission San Diego, Mr. Frank A. Kimball, of National City, in a paper read before the American Horticultural Society, at its meeting during the New Orleans Exposition, wrote as follows:—

In 1869, when this orchard was a century old, I counted three hundred and forty-seven trees at the old Mission of San Diego, and not a single perfect specimen could be found—a large number having been burned to a greater or less extent by camp-fires, while the mission was occupied by United States soldiers, at the close of the war with Mexico. The ancient walls having been broken down, this grove was open on all sides to the incursions of herds of cattle, horses, sheep, and goats. Many of the older trees had been cut down and used in the mess fires of the soldiers; the tops of many others had been cut or broken off and fed to sheep. For so many years had the fruit fallen and decayed, the accumulation of pits was so great that a spade could with difficulty be forced into the ground. The whole grove was overgrown with malva, and this so rank that a man on horseback would be hidden by it; and so full was the ground of holes, made by badgers and other animals, that one almost ran the risk of broken limbs in riding or even walking over it.

* "History of San Jose," by F. Hall (1871), p. 91.

This state of things was almost instantly changed when the grove passed into the hands of Thomas Davis, under a lease from the Catholic Church; and so profitable did the grove at once become that the lease was terminated for the purpose of securing a larger share of the profits, in which the representative of the church was not successful, and the orchard was again practically abandoned, but not until half the trees had been denuded of every young and thrifty branch. For years past this grove has been in the hands of those whose "tender mercies are cruel," and it is fast succumbing to the forest of gigantic malva; and to-day the wonder is that there exists a monumental olive tree to mark the spot where Junipero Serra laid the foundation of the first mission in California.

OBSERVATIONS BY GENERAL BIDWELL.—General John Bidwell, of Chico, favors me with the following notes on his observations in the mission orchards during the decade preceding the American occupation:—

The Mission of San Rafael had the best grapes—the "mission" grape, but better than elsewhere. It had also apples and pears.

The Mission of San Jose had an orchard and vineyard, five or six acres perhaps. The principal trees were olives and pears. The best early pear was called "Pera de San Juan." This mission I first saw in 1841. The trees were mostly seedlings, I think, at least the fruit was mostly inferior.

The largest orchard, as well as the largest trees, mostly pear trees, were at Santa Clara and San Jose (now the city of San Jose). There were also grapevines. All, both trees and vines, had belonged to the mission, and were of the kinds found at the other missions.

The Mission of San Juan Bautista, near Pajaro Valley, had also an old orchard, at least a few trees.

In January and February, 1845, I saw more or less of attempts to raise vines and fruit trees at other points, namely, Missions of San Miguel, San Luis Obispo, and Santa Ynez. The trees, like the missions, were in a condition of neglect and ruin.

Santa Barbara was better cared for; but the state of all the missions that I saw was, to a greater or less extent, that of neglect and decay, including San Buenaventura, San Fernando, and San Gabriel.

At the Mission of San Luis Rey there were orchards and vineyards, but everything in neglected condition—magnificent ruins, I might say. There were the remains of olive orchards, even then gone to utter ruin, hundreds of acres in extent. Pala and Temecula were dependencies of that gem of a mission.

The old Mission of San Diego had the finest of olives and pomegranates.

At the Mission of San Gabriel I found old vineyards and orange orchards, but all in a neglected condition. The orange trees had evidently been injured by frost, but not perhaps wholly killed.

The record which General Bidwell makes of the thrift and excellence of the fruit at the Mission of San Rafael is especially interesting, because it has been described as lacking in this respect, by Mr. Dwinelle, in a quotation already given.

But it seems that not all the mission orchards were permitted to fall into decay after the secularization. In 1846 Bryant found at the Mission San Jose two gardens inclosed by high adobe walls. The area was from fifteen to twenty acres, all of which was planted with fruit trees and vines. There were about six hundred pear trees and a large number of apple and peach trees, all bearing fruit in great abundance, the quality of the pears being excellent, the apples and peaches indifferent.*

* "What I Saw in California."

Other visitors to some of the mission orchards between the events of secularization and American occupation speak of being regaled with pears and milk, a dish which seemed to them ambrosial after their weary journeys overland across the deserts, or after months of ship fare.

PLANTINGS OF MISSION FRUITS BY EARLY SETTLERS.—There were quite considerable plantations chiefly of mission grapes and oranges by early settlers in the neighborhood of Los Angeles. General Bidwell says:—

> In 1845 Los Angeles had the largest vineyards that I had seen, and the vines were the most thrifty. Wine was also abundant,—even the Angelica. Los Angeles had orchards, also, mostly of oranges. The largest orange orchards at that time (February, 1845) were those of Wolfskill, Carpenter, and Louis Vigne (known as "Don Aliso," from the large sycamore tree standing by his house). The next year (1846) I saw oranges growing at Williams' ranch (about thirty miles from Los Angeles), also a vineyard and trees at Ocampo's ranch. Ocampo had wine and brandy which he had made.

Among the early planters of mission fruits in the northern part of the State was Yount, who planted vines in Napa Valley in 1838* and other fruits later. John Wolfskill, of Winters, saw grapes and peaches at Yount's in 1841, and J. M. Pleasant took peach pits from Yount's over into Pleasant's Valley, Solano County, 1851. Dr. Marsh, on his place at the base of Mount Diablo, had, according to Bryant, an "extensive" mission grape vineyard in 1846.† John Wolfskill visited Dr. Marsh in 1842, and tells me that he saw the doctor's vineyard at that time, and that it was more than an acre in extent, and in good bearing. He thinks the vines were planted about 1838. Mr. Wolfskill planted a few vines on Putah Creek in 1842, but did not plant fruit trees until about ten years later.

PARTIAL REVIVAL OF THE MISSION FRUIT GARDENS.—After the incoming of Americans in 1849 some of the old mission trees were secured by enterprising men, and made to renew their youth by pruning, cultivation, and irrigation, that they might minister to the great demand for fruit which sprang up among the gold seekers. The trees richly reciprocated the care and attention given them. The reports of the Visiting Committees of the State Agricultural Society have accounts of the new life of these old trees. Two instances are selected:—

> Thomas Fallon, of San Jose, has the best-producing pear trees, probably, in the State, having fruit of remarkable size and quantity, many of the pears measuring over fourteen inches in circumference. He has four old pear trees, planted by the old Spanish missionaries over sixty years ago, and grafted, in 1854, with Bartlett, producing three thousand pounds this season, which sold for $600.‡

* "Report California Agricultural Society," 1856, p. 13.
† "What I Saw in California," p. 303.
‡ Report California Agricultural Society," 1857, p. 42.

W. M. Stockton, near the Mission San Gabriel, has about three hundred pear trees, thirty or forty years old, all of them California seedlings, many of them of little or no value, and most of them becoming barren and going to decay. In March, 1851, he took the place in this condition, and began to prune and irrigate, both of which had been for a number of years neglected. In June of 1854 he began to bud and graft, and has continued until this time (1856). Six pear trees have been budded and grafted with twenty-five varieties of apples, and seventy pear trees with twenty-five varieties of pears. These apples and pears are very choice fruits, large, of excellent flavor, and very fine in appearance. One tree of California pears produced this season (1856) to the value of two hundred and fifty dollars.*

The first fruits offered for sale in the San Francisco markets were from the pear trees of Santa Clara and San Jose Missions, and from the mission grapevines of the same localities, and of Los Angeles County. These grapes, packed in sawdust, came up the coast by steamer, and were then reshipped to the mining camps, arriving for the most part in good condition, and were very popular. It is recorded that one thousand five hundred tons of these grapes were sent from Los Angeles County to San Francisco and the mines in 1852.† Another instance in which thrift followed neglect is seen in the fact that in 1858 Don Andres Pico, who succeeded to possession of the orchard at the San Fernando mission, did a considerable business in drying pears and other fruits, using the labor of the Indians.‡

At the present time vestiges of the old mission orchards still remain, the pears and olives still bearing, and in some cases the old date palms guarding the desolate scenes, or standing as reminders of the old *régime*, while the new life of California is surging up around them.

RUSSIAN FRUITS.

The second introduction of cultivated fruits to California was by the Russians. General Bidwell informs me that he saw at Fort Ross, in 1842, about half an acre of seedling apples and peaches, planted by the Russians at some time during their occupation of thirty odd years prior to 1841. Edward McIntosh had a small patch of grapevines near Bodega, in 1842; and at that date there was a small vineyard between Bodega and Fort Ross, half an acre in extent. This had been planted and owned by a Russian gentleman of leisure, by the name of Don Jorge. These grapes were said to be of a better variety than those cultivated at the missions; but though they had borne fruit, yet the pruning and little attention which General Bidwell was able to give were not such as to restore them. The place was too shaded by the redwood forest, the soil too wet, grass too luxuriant, deer, hare, and cattle too plenty, fences too poor, etc.

* *Loc. cit.*, 1856, p. 20.
† J. S. Waite, in "Patent Office Report," 1853, p. 299.
‡ "Report California Agricultural Society," 1858, p. 294.

There was afterward a limited distribution of Russian seedling fruits in the section contiguous to the Russian settlement, but their contribution to the distribution of fruits in California was infinitesimal as compared with the achievements of the padres. The Russians seemed, however, to have had some desirable varieties, for there is now grown in Green Valley, Sonoma County, a medium-sized, bell-shaped apple, lightly striped with red, which is called the Fort Ross or Russian apple, and was probably propagated by grafts from the Fort Ross orchard.

CHAPTER VI.

INTRODUCTION OF IMPROVED FRUIT VARIETIES.

THE first cultivated fruits of the old era came to California with the padres. The first fruits of the new era came with the American pioneers. Though not a little inquiry has been made, it is not yet possible to declare definitely who brought the first budded or grafted trees upon California soil, and it is hoped that this statement may induce someone to disclose this historic fact, which is of much interest in view of our wonderful growth in fruit production. Perhaps the first improved varieties of deciduous fruits arrived in 1846. B. M. Lelong, secretary of the California Board of Horticulture, says that it is a tradition in his family that his father, the late Martin Lelong, who came to California as a member of Stevenson's regiment, brought with him a small lot of French varieties of apples growing in a box, and that they were planted in Los Angeles. Some of the trees are still standing. The fruit is certainly not of popular American varieties, but had a superiority over the mission seedlings, which led to the use, in the vicinity, of scions from the Lelong orchard at a very early date.

In the fall of 1849 W. H. Nash, now a resident of San Francisco, joined with R. L. Kilburn in ordering from a nursery in Western New York a small box of thirty-six fruit trees, which, packed in moss, well survived the journey around the Horn, arriving and being planted in Napa Valley in the spring of 1850. The shipment included Rhode Island Greening, Roxbury Russet, Winesap, Red Romanite, Esopus Spitzenburg apples; Bartlett and Seckel pears; Black Tartarian and Napoleon Bigarreau cherries.

Before this introduction of grafted fruit trees, and, indeed, for several years afterwards, there were many shipments of fruit-tree seeds from the Eastern States to California. Mr. Barnett, of Napa, planted Kentucky seed as early as 1847. T. K. Stewart says that he brought to California with him, in 1848, about two hundred pounds of vegetable and fruit seeds, the latter including peach, pear, and apple; all of which were planted on the American River, within the present limits of Sacramento, in the spring of 1849. At the same time he planted figs and

olives, and, in 1851, seeds of oranges. From all of these he secured bearing trees.*

But these early efforts at improvement of California fruits were but faint forerunners of the zeal and enterprise which followed the great invasion by gold seekers. As soon as the first thought—to get gold directly from the soil—would admit the second—to get it indirectly, by agricultural and horticultural arts—there came a demand for something better than the wild fruits of the mountains, better and more abundant than the fruits from the mission orchards. At first everything in the line of fruit-tree seed which could be obtained was planted. Thus the immediate vicinity of the mines soon began to show growing fruit trees. But seedlings of any kind would not satisfy the planters, and effort was put forth in every direction after grafted trees of the best varieties. Oregon had a few years the start of California as an inviting field for immigration, and the advantage also of winning the attention of those who went out, not as gold seekers, but as agricultural producers. Oregon had grafted trees in bearing, and nursery stock as well, about the time the demand sprang up for it in California. Its introduction was then, however, of very recent date. Up to 1847 the cultivated fruit of Oregon consisted of seedlings introduced by the Hudson Bay Company. In that year occurred the first considerable, if not the very first, introduction of grafted fruit upon the Pacific Coast. The story of that venture has been so often wrongly told that it is well to record its interesting incidents in the words of one quite near to the event, if not actually participating in it. Seth Lewelling, of Milwaukee, Oregon, writes;—

In 1847 my brother, Henderson Lewelling, crossed the plains from Henry County, Iowa, to Oregon, bringing with him a pretty general variety of grafted fruits. He fitted up a wagon for the purpose, selected small plants, and planted them in soil in the boxes, and watered them to keep them alive. He told me that in some places he had to carry water a mile, up the mountains, to save his trees. When he arrived in Oregon, late in the fall, he had something over three hundred plants alive. The same fall William Meek arrived in Oregon with a few varieties of fruit trees. He and my brother put their stock together, and commenced the first nursery of grafted fruits on the Pacific Coast. It was situated five miles south of Portland, just below Milwaukee, on the east bank of the Willamette River. For want of seedling stock they could not increase their nursery much until, in 1850, my brother John and I crossed the plains, bringing with us some apple seed, which we planted that winter. We also found a gentleman, named Pugh, in Washington County, Oregon, who had planted some apple seed in the spring of 1850, which had grown well, and we bought his stock. During the winter of 1850–51 we put in about twenty thousand grafts. In March, 1851, I went to Sacramento, taking with me a box of grafts of apple, pear, peach, plum, and cherry, and sold them in Sacramento. I believe I have the honor of being the first to distribute grafted fruit in California.†

*"Report California Agricultural Society," 1870, p. 159.
†Letter to the author, November 17, 1887.

Such is the record of the first large undertaking in supplying choice fruits to the Pacific Coast, and the first commercial venture with such fruits in California. Of the original partners in the importation, both settled subsequently in California, Henderson Lewelling in 1854, and William Meek in 1859, and built up splendid properties near each other, in Alameda County. John Lewelling also came early to California, planted the famous Beard & Lewelling orchard in 1853, and subsequently was active in other localities. These three honorable and enterprising men now "rest from their labors, and their works do follow them."

OTHER EARLY INTRODUCTIONS.—The introduction of grafted trees, for sale by Mr. Lewelling in the spring of 1851, was quickly followed by other commercial importations, and by shipments by planters for their own use, so that the plantings of 1851–52 were quite large. Still there was great doubt as to the success of the trees. The late G. G. Briggs, after his great melon profits of 1851,* went back to New York State for his family, and, returning to California, brought with him, as he says, "with no idea that they would succeed, but as a reminder of home," fifty peach and a few apple and pear trees. To his surprise the trees grew well in 1852, and the next year blossomed and bore some of the best peaches he ever saw. The pears also bore some fine fruit the same year. He at once ordered one thousand four hundred peach trees from the East, of which one thousand were lost on the steamer *Golden Gate*, and the four hundred arrived, and were planted in December, 1853, and bore a crop in 1854, which sold at the rate of $1.50 a dozen, and yielded $2,800 from fifty peach trees only one year from placing them in orchard. Naturally Mr. Briggs extended his operations, bringing seven thousand more peach trees in 1854, and, continuing his planting, he had, in 1858, one thousand acres in orchard—peaches, pears, nectarines, apples, apricots, cherries and plums.† That year he noticed the first ill effects of the down-flow of mining *débris*, which finally ruined this splendid property. In 1858 the yield of Mr. Briggs' orchards was five hundred and eighty-seven thousand six hundred and twenty-eight pounds of fruit, which sold for sixteen cents per pound. The total cost of production and marketing was six cents a pound, leaving a net profit of $58,762.‡ In that year Mr. Briggs was awarded the gold medal by the State Agricultural Society, the first prize for a first-class orchard. The destruction by *débris* came upon the property just as it should have reached

*"Report California Agricultural Society," 1858, p. 169. From twenty-five acres of watermelons near Marysville, Mr. Briggs derived a net profit of $17,000.

†Statement by G. G. Briggs, in "Report California Agricultural Society," 1881, p. 181, *et seq.*

‡Report, 1858, p. 170.

its full production, for the flood of 1861–62 brought down mud and slickens upon it to a depth of one to three feet, and drift-wood, which broke down and bruised the trees; and, turning his back upon the enterprise which should have yielded him immense rewards, Mr. Briggs sought other fields for planting. The history of this orchard is thus briefly sketched because it was one of the most famous of pioneer days.

Besides the introduction of grafted trees which have been mentioned there were others in 1852, for, at a fair held in San Francisco in 1853, there were several kinds of apples, grown by Isaac A. Morgan, of Bolinas, on trees planted the previous year.* Apples were also shown from Napa. David Spence, of Monterey, showed the first almonds grown in California.† During the winter of 1852–53 the distribution of grafted trees must have extended widely over the State. Five dollars for a small tree was frequently paid at the nursery of Meek & Lewelling, in Milwaukee, Oregon, and the trees were carried overland into the mining districts of California, as well as brought to San Francisco for distribution through the valleys.

DOUBTS DISPELLED.—But interesting as are the details of the early deeds, too great space cannot be given to them in this connection. It is rather upon early methods than men that the interest of the present generation will center. At first, though there was the testimony of the successful growth of fruits at the missions, there seems to have been, as has been stated, much doubt as to the fate of extended plantings. But the doubt was quickly dispelled. Capron writes:—

> It has been doubted whether the apple and peach would flourish in the State. Persons but imperfectly acquainted with the climate have suggested that the heat of the dry season is too great and of too long duration for the perfect development of the apple, and the nights too cold for the tender peach; but experiments, which have been made with grafts, and with fresh trees transplanted within the last three years, show the fallacy of these doubts. Large, fair apples and peaches, of different species and of excellent flavor, were gathered, in the season of 1853, from trees and grafts but two years old.
>
> All that is necessary to secure success in this State, in the cultivation of any of the fruits which can be grown north of the tropic, is a sufficient knowledge of the nature of the several fruit-bearing trees to be able to select for them favorable locations for planting orchards.‡

It is interesting to note how early the secret of success in California fruit growing was thus announced. Though we have learned much during the last third of a century, we cannot improve upon the last sentence, quoted above, as a general proposition concerning fruit growing in this State.

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*San Francisco *Alta*, October 7, 1852.
†*California Farmer*, January, 1854.
‡E. S. Capron, "History of California," 1854, p. 111.

FRUIT GARDENS, NOT ORCHARDS.—It is interesting to note that much of the pioneer effort was expended upon fruit gardens rather than fruit orchards. Two ideas, at least, led in this direction. One was the popular thought, which, however, was very early found to be erroneous, that frequent and copious irrigation was essential to the growth of fruit in this dry climate. Another was the ambition, which was correct, both from a horticultural and commercial point of view, to secure the fruit just as soon as possible, for the double purpose of determining what was adapted to the novel conditions, and to secure the magnificent prices which fruit commanded in the market. For these ends dwarfing stocks naturally suggested themselves, and were employed to an extent which seems wonderful when it is remembered that now hardly a fruit tree in the State is worked upon a dwarfing stock. Very early, say from '52 to '58, at San Jose, Oakland, Stockton, and Sacramento, small areas, which would now only be considered respectable house lots, were turned to great profit with dwarf pear and apple trees. The place of Mr. Fountain, near Oakland, was called, in 1857, "the finest orchard of dwarf trees in the State." It consisted of three acres set with one thousand, six hundred apple and pear trees, all dwarf from root grafts, two years old, and four feet high, and most of them in good bearing. He started the branches from the ground, pruning severely, and heading in during the winter. He claimed that dwarfing gave him better and larger fruit, and from two to three years sooner than with standard trees. He did not irrigate, but plowed frequently, four inches deep up to the 1st of June. The soil was a sandy loam.* J. R. Lowe, of San Jose, a landscape gardener, who seems to have laid out many of the fruit gardens in his neighborhood, had of his own two acres, upon which, "besides his house and barn, were over twenty four thousand fruit trees—cherry, pear, plum, peach, apricot, and nectarine, many of them in bearing."† More wonderful still in the way of utilizing small space was the garden of Thomas Fallon, also of San Jose, where there were, "on less than twenty feet square, fifteen pear trees of several varieties, bearing more fruit than wood, some weighing over two pounds, one limb, eighteen inches long, bearing twenty-two pears, weighing over one and one-half pounds each. The fruit of this little garden of thirty trees sold for $1,600; soil, a rich, light loam, well cultivated and watered."† These statements are not individual reports, but are from the reports of "visit-

* "Report California Agricultural Society," 1857, p. 49.
† *Loc. cit.*, p. 42.

ing committees" sent out by the State Agricultural Society, in the years cited.

But though these dwarf-tree gardens were formally declared "to be the fashion," and though the list of stock of one Sacramento nurseryman, in 1858, included ninety-five standard and eight thousand and sixty-eight dwarf pear trees for sale, the foundations of the greater orchards were early laid upon the basis of standard trees. Thus the Briggs' orchard, of one thousand acres, on the moist land of the Yuba, was planted with trees sixteen feet apart each way, and Mr. Lewelling, and other early planters on the rich lands of central Alameda County, adopted about the same distance.

Quite in contrast, too, with the prevalence of dwarf trees, and contemporaneous with it, was the grand plan upon which the pioneer of pioneers, General Sutter, laid out his orchard on Hock Farm, on the west bank of the Feather River, eight miles from its junction with the Yuba, of which the following description was written about the time the trees were coming into bearing:—

> Several acres were set apart for an ornamental fruit orchard, the trees and shrubs being so arranged as to present a unique landscape garden, nearly every article in which is productive of fruit. . . . The arrangement of the fruit trees is peculiar, a large portion of them being set on either side of the broad avenues opening through the extensive grounds in various directions, imparting to the whole an air of picturesque beauty seldom seen.*

But neither the narrow dwarf-tree garden plan nor the broad landscape-garden plan has survived. Neither of them harmonized with the commercial idea of orcharding—large production and economy of cultivation, and both are now but curiosities of the early horticulture of California.

IRRIGATION ABANDONED.—The early abandonment of dwarf trees suggests also the early abandonment of irrigation in the valleys of Northern California—as early as 1856. Facilities which had been secured for irrigation of orchards were allowed to go unused, because it was seen that it was better not to use them. One case is reported in Napa County where means to furnish the orchard with thirty thousand gallons of water per day were allowed to lie idle.† The substitution of cultivation for water, of course, attended this reform. The announcement of a practice, in 1856, "to plow deep, dig wide and deep holes for planting, and work the ground from February to July, allowing no grass or weeds to grow among the trees,"‡ shows that the thorough and clean culture, for which California is famous, is

* Report, 1858, p. 167.
† "Report California Agricultural Society," 1856, p. 12.
‡ *Loc.cit.*, p. 12.

not a recent idea in our practice. Even the abandonment of the plow, and almost weekly use of the cultivator, was the practice of some growers in the San Jose district as early as thirty years ago.* In fact, the descriptions of orchard management in that day include nearly the whole variety of methods which now prevail. Even the "no irrigation" placards at fruit fairs, which have become quite a prominent trade-mark of the northern "boom" movement of to-day, were used a generation ago as a war-cry between methods instead of localities.

EARLY WISDOM AND ENTERPRISE.—It is evident to anyone who studies the records that California was very fortunate in numbering among the early settlers so many men with horticultural tastes, skill, and experience. The rapidity with which fruit trees were multiplied, and the confidence with which these early comers entered upon the nursery business, shows their training. Although there were many trees brought here from the East and from Europe, they constituted only a very small percentage of the plantings of the first few years, but the orchards, with the exception of a very small number of trees introduced to furnish grafting and budded stock, were the product of the soil. When this is borne in mind, it becomes all the more wonderful how so much could be done in a new country, in a distant part of the world, in so very short a time. It was an observation which was put upon record as early as 1856, that "some varieties of fruit are much improved by change to this State, and some are not benefited." The test seems to have been that if a variety was not better here than at the East, it should be discarded.

The behavior of the fruit trees which they planted in California was a surprise to the experienced horticulturists who planted them. The problems which arose in their minds are very interesting to recall, and fortunately some of these are recorded in the report of the Convention on Fruits, at the State fair of 1857. The committee was composed of seven, and some of their names have become famous in our horticultural annals. The following is an extract from their report:—

> It is well known to all who have followed fruit growing as a business, that the first crop on a young tree will often vary very much from the original type. Just so in California, where that business is yet in its infancy. It is true general characteristics can most always be detected, but there is such a wonderful tendency (we cannot call it anything else) to redundancy; such extraordinary bearing, young trees of three and four years sustaining such abundant crops of large, heavy fruit, and the richness of flavor also keeping pace with the prolific character of the trees and the extraordinary size of the fruit, especially of apples, pears, peaches, plums, apricots, etc., that at first sight it is no wonder their old friends hardly know that this tendency to

* Report, 1857, p. 43.

precocious bearing and extraordinary size of some specimens of apples, pears, peaches, etc., in the first crop on young trees is not entirely peculiar to California; and many have been anxiously watching for the last two or three years to see if, as the trees advance more toward maturity, they show any tendency to fall back in their size, crop, and flavor, to their common character in their old Eastern home. But hitherto no such tendency is observable, except in some few cases, where improper management, bad culture or overbearing, has evidently been the cause. Wherever the trees have been well cared for and not allowed to overbear, the great increase of size and richness is still apparent, and every year adds testimony that all the varieties of apples, pears, peaches, plums, etc., will have in this country a decided California character, viz., largeness of size, increase of weight, brightness and richness of color and sweetness of flavor.*

THE FIRST OVERSUPPLY.—The wonderful stimulus given to the fruit interest by the results attained in growth and in marketing, soon induced larger plantings than the demand warranted. In 1857 it was publicly stated that "there are single farms in this State, containing each over half a million fruit trees in orange and nursery—one person owning enough trees, when fully matured, to produce as much fruit, other than grapes, as will be sold this year throughout our State. The day is not far distant when fruit will be an important crop for raising and fattening swine."† This was to a certain extent a statement of a croaker, for plantations continued, rare varieties were brought from the East, the South, and from Europe; the growth of some fruits continued to be very profitable, and the nursery business, confined to fewer hands, was profitable also. The idea that quality rather than size should be striven for led to more discrimination in propagation and better treatment of trees.

The decade from 1858 to 1868 was one of quiet in the fruit interest of California. Many of the too hastily and carelessly planted trees died from lack of proper cultivation and pruning, and the borer wrought sad havoc. In 1860 and 1861 there was serious depression. It is recorded that peaches were worth but one cent a pound and many were allowed to go to waste as not worth gathering. The flood of 1862 destroyed many trees along the Sacramento River, and replanting was slow until prices began to improve, as they did soon afterward.‡ The rapid development of the mining interest in Nevada, and the construction of roads across the Sierras, opened the way for the disposition of much fruit grown in the foot-hills and in the region around Sacramento.

The imports of dried and canned fruits were large and growers were exhorted to take steps to secure this trade for

* Report of Wm. Daniels, B. S. Fox, J. D. Morey, L. A. Gould, Jas. Bell, E. B. Bateman and J. L. Burtis, "California Agricultural Society," 1857, p. 59.

NOTE.—In the first edition of this work tables are given citing incidents of great size and weight of fruit, precocity of trees and vines and large receipts from fruit crops in early years.

† "Report Agricultural Society," 1857, p. 103.

‡ *Loc. cit.*, 1871, p. 459.

themselves. Something was done in this direction, for by 1867 the local product of canned fruit was equal to the demand.* Drying did not advance so fast, for two years later there were imports of six thousand barrels of dried apples, while the hundreds of thousands of bushels of the fruit were rotting under the trees in our orchards.†

The decade under review was also notable for the first appearance of cured raisins and prunes at the State fair of 1863. The raisins were from the Muscat of Alexandria grape, and the report states that so-called raisins exhibited previous to that time were merely dried grapes.‡ Dr. J. Strentzel, of Martinez, was the first exhibitor of Muscat raisins, and he exhibited also dried grapes of four varieties to show the contrast between a raisin and a dried grape. J. R. Nickerson, of Placer County, exhibited the dried prunes, which were of the German variety.‡

Though this decade was one of uncertainty and doubt, there were rich lessons of experience learned, and the foundations for coming greatness were well laid.

THE NEW ERA.—Another era in California may be marked as beginning with the year 1869, because then the first fresh fruits were sent East over the newly-opened overland line. This period of our growth is too recent to warrant prolonged discussion. The incidents, many of which are not pleasant to recall, are within the memory of many. The first season's shipments amounted to thirty-three tons of pears, apples, grapes, and plums; in 1870 seventy car loads, or about seven hundred tons, were sent. Alluding to these shipments, in an address before the State Agricultural Society, in 1871, Mr. C. W. Reed, of Sacramento, said: "The business of shipping green fruit should increase until we can send one thousand car loads annually from California." Mr. Reed has lived to see this limit far exceeded. as the following statement, furnished by the Southern Pacific Railroad Company, of the shipments for the series of years, with the "average line rate" of freight charged per one hundred pounds, will show.§

The following table will serve as a good indication of the recent rapid advancement of the fruit interest of California, though of course it does not cover our aggregate product, nor even our surplus product, for shipments are also made by sea to near and distant points.

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* *Loc. cit.*, 1867, p. 35.

† Report, 1869, p. 22.

‡ "Report California Agricultural Society," 1863, p. 88.

§ By "average line rate" is meant the total charge for freight to the Missouri or Mississippi Rivers, divided by the pounds shipped for the season, either by slow freight or passenger train.

The statement for green fruit includes oranges.

The Eastern shipment of fresh fruits began its new era with the year 1886, in which the California Fruit Union was organized by fruit producers to secure freer shipments and wider distribution. Both by its own shipments and by those of outside shippers, who were stimulated into new activity by this movement of growers in their own interest, the aggregate for the year was increased over that of previous years. In this year, also, the first full train load of fifteen cars of fresh fruit from deciduous trees went overland. Shipping train loads of oranges from Southern California began at an earlier date.

SHIPMENTS OF CALIFORNIA FRESH AND DRIED FRUITS.

YEAR.	FRESH FRUITS.		DRIED FRUITS.		RAISINS.		CANNED FRUITS.	
	Pounds.	Rate.	Pounds.	Rate.	Pounds.	Rate.	Pounds.	Rate.
1871....	1,832,310	$3 38	.....	.....	.....	.....	.....	.....
1872....	2,039,972	3 38	.....	.....	.....	....	182,090	$3 51
1873....	2,896,530	3 38	.....	.....	.....	.....	678,580	2 00
1874....	5,029,840	2 50	.....	.....	220	$2 81	457,290	1 50
1875....	2,993,720	2 50	548,227	$2 50	.....	1 75	759,040	1 50
1876 ...	4,201,730	2 50	630,770	2 50	68,440	1 75	1,529,910	1 50
1877....	3,818,310	2 50	730,710	2 50	239,260	1 75	1,731,530	1 50
1878 ..	2,866,420	2 50	259,170	2 50	192,890	1 75	1,700,930	1 50
1869....	3,126,400	2 00	1,761,750	2 00	942,770	1 50	3,111,680	1 50
1880....	3,141,500	2 00	412,480	2 00	669,660	1 50	6,707,650	1 50
1881 ...	7,248,300	2 00	2,074,420	2 00	1,490,320	1 50	18,768,200	1 50
1882....	7,919,340	2 00	4,532,350	2 00	868,770	1 50	25,163,190	1 50
1883....	19,222,580	2 00	3,097,950	2 00	295,050	1 50	26,397,700	1 25
1884....	11,996,070	1 50	2,103,350	1 50	3,150,290	1 50	21,695,740	1 25
1885....	45,386,740	1 85	5,794,160	2 30	6,203,340	1 25	28,949,380	1 16
1886....	49,665,650	1 34	6,113,970	....*	12,970,800	.. *	30,636,710	....*
1887....	50,732,990	1 38	16,648,220	....*	15,976,500	....*	56,009,130	....*
1888...	53,741,670	1 37	19,759,140	1 20	16,884,570	1 13	39,281,340	94
1889....	65,428,390	1 31	33,010,890	1 17	17 422,510	1 15	33,586,990	88
1890....	87,277,430	1 19	43,811,450	1 13	28,860,920	1 14	80,465,080	84

THE FRUIT INTEREST IN 1891.—The fruit interest is being most rapidly extended. The disposition to plant fruit trees is as active as ever, and nurseries are well emptied of desirable stock. The wine-grape interest is not at the moment extending, because of the low prices of the last four years. The remedy is in the wider popularization and distribution of California wines, and this is being zealously striven for by producers.

There are no authoritative figures of the present fruit acreage and productions of the State, but the following may aid in forming an idea of the facts:—

* The average rates for the years 1886 and 1887 are not given because the war of rates prevailing between trans-continental lines in those years would make the average unduly low. The range for dried fruit during that period was $1.15 to 57½ cents; for canned fruit, $1.25 to 62½ cents; and for raisins, $1.30 to 65 cents.

CALIFORNIA FRUIT STATISTICS OF 1890.

Fresh fruit shipped overland (net weight)	lbs.	70,000,000
" " dried, including raisins	"	237,000,000
" " canned (3,200,000) cases	"	114,400,000
" " used for 17,000,000 gallons wine	"	221,000,000
Total number fruit trees growing March 1, 1891	"	15,000,000
" " acres grapevines growing March 1, 1891	"	225,000

As stated above, these figures are but approximations, and the local consumption by one and a quarter millions of fruit-eating people is not included. The State should provide for accurate statistics of all her rapidly-growing industries. There should be data for noting the steps of the advance, which promises to make all present achievement appear but little more than a suggestion of the real industrial development of California.

PART SECOND: CULTURAL.

CHAPTER VII.

CLEARING LAND FOR FRUIT.

THE greater part of the orchard and vineyard area of this State was naturally almost clear for planting. The removal of large trees, which paid the cost of the work in firewood, or the grubbing out of willows on some especially rich bottom land, was about the extent of clearing which our earlier planters had to undertake, and by far the greater part of them perhaps never had to lift an ax. Even now, aside from the development of the foot-hill country, very much of the land which is going into orchard is open grain field, and the vine planters have done the greater part of the clearing, as they find the warm hillside especially adapted to the grape. Still there has always been some clearing done, here and there, even since the earliest days, and now that hill lands are being sought out by settlers, and their peculiar value for some fruits is being more generally recognized, it is to be expected that far more clearing will be done in the next few years than in all the history of California up to this time, and it is not unlikely that some of this reclaimed land will be regarded in the future as among the most valuable fruit lands in the State.

The lands which need clearing are in the main the foot-hill slopes of the Coast Range and the Sierra Nevada. In the South there is besides, sometimes, the *débris* of the desert flora to clear away when water is secured and the rich wilderness is subdued. This work is, however, so easily accomplished that it hardly rises to the dignity of "clearing," as understood by the Eastern mind.

GROWTHS CHIEFLY ENCOUNTERED IN CLEARING.

Although it will not be worth while in this connection to enumerate all of the great variety of shrubs and trees which the settler lays low in his clearing, it will be interesting, perhaps, to designate a few which constitute the bulk of the growth and are

most frequently alluded to in conversation. The grand trees which figure most largely in lumbering operations are not included because they are not met with as a rule in foot-hill clearings. The trees which the settler encounters are rather the degraded valley growths, which, though assuming grand proportions in the valleys, become "scrubs" amid the harsher environment of the hillsides. This is notably true of the oaks and of some other trees.

THE OAKS.—Our grand white oak (*Quercus lobata*), a large, stately tree, is common throughout the State, both in the valleys and on the foot-hills of the Sierra Nevada, and in the southern part of the State reaches even higher up the sides of the mountains. The blue or rock oak (*Q. Douglasii*) is smaller than the preceding, and limits its habitat to the foot-hills of the Coast and Sierra Nevada Ranges in the central zone of the State. The live-oaks (*Q. chrysolepsis* and *Q. Wislizeni*) are among our largest oaks, but become low shrubs at higher altitudes. This is also true of our black oak (*Q. Kelloggii or Sonomensis*); this and the post oak (*Q. Garryana*), which is associated with it, are the species that give the settler his hardest work, because of their abundance on the Coast Ranges. The former also occurs on the western side of the Sierra Nevada, where it is often reduced to a shrub. Another black oak which suffers similar degradation is *Q. agrifolia*, though in this case the shrubby form is classed as a variety, which is but three to five feet high, while the true species maintains much of its dignity wherever it is found. It is limited to the coast region and multiplies south of San Francisco, though occasionally found northward to Mendocino County. It is classed as an evergreen oak, though it has a way of losing most of its leaves before the new spring growth appears. The evergreen white oak, or live-oak, of San Diego and Los Angeles Counties (*Q. oblongifolia*) extends its area eastward to New Mexico and southward. The tan bark oak (*Q. densiflora*) and the chestnut (*Castanopsis chrysophylla*), or chinquapin, also occur in the fruit belt, often reduced to mere low shrubs. There are other oaks which the settler is apt to meet, as the botanists name about fifteen species as existing in California; the ones mentioned are, however, those most likely to be encountered.

THE CONIFERS.—Though the Pacific Coast is rich in conifers, there are only a few species, comparatively, which confront the tree or vine planter, because the range of the others is outside the fruit belts. The species which cling to the seacoast, or the others which delight in the higher mountains, need fear only the

seeker for fuel or timber. Along the Coast Ranges from San Luis Obispo northward are the redwoods (*Sequoia sempervirens*); and southward to San Diego, the California juniper (*Juniperus Californica*), the latter a stout tree from twenty to twenty-five feet in height. Occasionally, too, in the Coast Ranges one finds the arbor vitæ (*Thuya gigantea*) and the white cedar (*Libocedrus decurrens*), in lands to be cleared. The firs choose a higher elevation, but the Douglas spruce (*Pseudotsuga Douglasii*) is abundant, and the hemlock spruce (*Tsuga Mertensiana*) somewhat rarer, in the Coast Ranges north of the bay of San Francisco. The pines, too, are for the most part out of the region of the fruit grower, except the small, knobby cone pine (*Pinus tuberculata*), which occurs in the Coast Ranges from the north to south and also on the Sierra Nevada, and is called the scrub pine of California. The Digger pine (*Pinus Sabiniana*) is the conifer, which the land clearer most frequently has to contend with, both in the foot-hills of the Coast Range and the Sierra Nevada. This is the tree which the late B. B. Redding spoke of as a sort of indicator of foot-hill fruit land, as it does not grow in the valley, nor higher up the mountains than fruit trees may be expected to flourish. Another species similar to this is the great cone pine (*Pinus Coulteri*). It has, however, thicker, stiffer branchlets and leaves and occurs in the Coast Ranges from Monte Diablo to the southern boundary of the State.

OTHER TREES.—Among trees less dignified than the foregoing, but in many cases more abundant, may be mentioned the California buckeye (*Æsculus Californica*), a fine, large, symmetrical tree in the valley, but usually on the hills a shrub ten to fifteen feet high, which occurs all through the fruit belt of the Sierra foot-hills and on the Coast Range from San Luis Obispo northward. Also abundant in the Coast Ranges, but less frequent in the Sierra foot-hills, is the madrone (*Arbutus Menziesii*), which is usually a small tree or shrub south of San Francisco, but a large tree northward. The same is true of the mountain laurel or spice tree, often called the California laurel or California olive (*Umbellularia Californica*); it occurs on the uplands all through the State, but is smaller on the Sierra than on the Coast Ranges and in the South than in the North. Common on the hills also are the alders, species of *Alnus*, peculiar to this coast and yielding hard wood for fuel, and occasionally the broad-leafed maple (*Acer macrophyllum*). Along the streams are the California box elder or soft maple (*Negundo Californicum*), the Pacific yew (*Taxus brevifolia*), and upon bottom-lands everywhere many species of willow, the clearing of which has

yielded some of the most famous fruit lands in the State. The bottom-lands in the interior parts of the State also grow cottonwoods of several species, the local sycamore (*Platanus racemosa*), the ash (*Fraxinus Oregana*), and a tangled thicket of native grape-vines.

CHAMISAL AND CHAPARRAL.—Of true shrubs to be removed, it will only be possible to name a few of the most abundant. The common manzanita (*Arctostaphylos manzanita*) occurs on dry ridges everywhere, both on the coast and at great elevations, sometimes only growing a few inches from the ground, sometimes rising eight or ten feet. Next to this, perhaps, the two terms which the land clearer has most to use are "chaparral" and "chamisal." They are sometimes used rather indiscriminately, as to botanical application, and are made to comprehend the greater part of all the underbrush which the settler has to contend with. To distinguish between them it may be said, however, that the term chamisal properly applies to the shrub *Adenostoma fasciculatum*, var. *obtusifolium*, which is abundant on dry soils in the Coast Ranges and more rarely in the foot-hills of the Sierra Nevada, often covering extensive areas with dense and almost impenetrable growth, producing an effect on the landscape like that of the heaths of the Old World. Another species, *A. sparsifolium*, with narrow, scattered leaves, is sometimes abundant on the mountains east of San Diego.

By chaparral is generally meant shrubs of several species of *Ceanothus*, forming dense thickets and giving its name to certain soils on which it most abounds, both in the Sierra foot-hills and the hillsides of the Coast Range, where it is known as California lilac. The genus includes the "flat brushes," as they are called, from their trailing on the ground, or low, horizontal shoots.

OTHER SMALL GROWTHS.—Shrubs of frequent occurrence also are the poison oak (*Rhus diversiloba*), chiefly on the north sides of hills in all parts of the State, but most abundant in the Coast Ranges, and other species of *Rhus* which are not poisonous; the hazel-nut (*Corylus rostrata*), which has been mentioned in the chapter on wild fruits; the buckthorns, of which several species are well distributed on the hillsides and mountains of the State, and one (*Rhamnus Californica*) achieved a fleeting local reputation as "California coffee."

In some parts of the State there are also large areas of sage-brush or wormwood made up of several species of *Artemisia*, sage or chia, two species of *Salvia*, and the famous white and black sages of the bee-keepers, which are species of *Audibertia*,

occurring chiefly on the mountains of Southern California. Add to these the spireas, the azaleas, the rhodendrons, the sweet-scented shrubs (*Calycanthus*), etc., and include nearly all the wild fruit trees, bushes and vines mentioned in a previous chapter, and one will gain the idea that though California is widely considered a bare State, the land clearer has a host of plants confronting him and disputing his right to the soil.

COST OF CLEARING.

The cost of clearing on the foot-hill slopes of the Sierra Nevada and the Coast Ranges is too variable to admit of estimates except such as may be made on the spot by experienced persons. The cost varies, of course, according to the density of the growth of trees and underbrush, and the rate of wages to be paid. Though in some cases higher cost is reached, probably as a rule the expense of clearing will be from $5.00 to $30 per acre, less whatever the fire-wood might be worth. In exceptional cases, where there is a large growth and a good wood market near by, the wood may pay the expense or more; even the roots of chaparral sell in our cities at $3.00 or $4.00 per cord. It sometimes happens that charcoal can be produced to advantage; in fact, there are now orchards upon land which was secured in the first instance for the charcoal to be made upon it. Usually, however, the clearing is an item of expense and must be reduced as much as possible by working in the most economical and effective way.

Though in most cases of clearing by the actual settler himself the problem is merely one of muscle and persistence, some few hints may be given from the experience of others which may be useful. Spare time during the summer and fall can often be used to advantage with a sharp ax in trimming up the smaller trees, which are large enough to yield fencing material, and geting out posts from the redwoods and oaks, and rails and pickets from the pines. By thus using the waste material the settler can often get out enough fencing material to inclose his land and thus save considerable expense. Brush, too, which cannot be made use of can be lopped off—in short, all the sharp ax work can be done in a dry time. The actual clearing, however, should be done in the winter, when the ground is wet and soft, and digging is easy or "snaking out" is possible.

PARTIAL AND THOROUGH CLEARINGS.

Orchards are planted on both partially and thoroughly cleared land. By the former practice clearing enough is done to give space for the tree holes, the *débris* is burned up, and the trees

planted. In this kind of work the stumps are left to be taken out at a convenient season, the object being to get fruit trees to growing as soon as possible. Where one is working with little more than his own muscle, and has no capital, this sort of planting is better, perhaps, than not planting at all, but it must be borne in mind that all subsequent work will be done at a great disadvantage, and as cultivation is likely to be very imperfect, it would be a question whether in the end anything would be gained by such a plan. The encumbered character of the ground will, of course, prevent the use of the horse in cultivation until most of the stumps are removed. Aside from this, decaying stumps and roots in the soil often kill the young trees; especially is this the case with old oak stumps.

Clearing of land for orchard or vineyard is a very different thing from clearing for pasture, as is done in the redwood region of the northwest Coast Ranges of the State, where the stumps are untouched, the trees not taken by the lumberman are girdled and left a prey to decay and storms, and the brush slashed and burned every few years to prevent it from completely taking possession of the land. Clearing for fruit should be thorough, everything which will interfere with good cultivation removed; roots grubbed so that as little shooting up as possible is secured; the ground evened up to obviate standing water, and, where needed, arrangements made for irrigation and drainage, as will be considered later.

REMOVAL OF TREES.

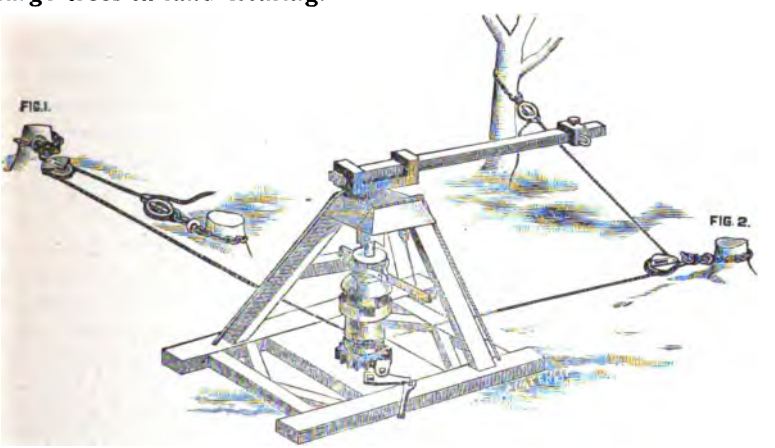
The first operation in clearing will be the removal of the trees. This can be partly done in the dry season if one has unemployed time. In such case the tree is felled and worked up into fire-wood and the stump left for subsequent treatment when the ground is moist. Unless there is idle time to employ, the whole work can, however, be better done in the winter, for then the top of the tree may be made to help pull out its own roots. This is done sometimes by digging out the soil and cutting off the main lateral roots below the depth to which the plow will reach. By thus reducing its anchorage the tree will topple over or may be pulled over with a team and tackle and it will usually lift out its stump quite effectively.

A STEAM PULLER.—An arrangement for tearing out trees without digging was invented in 1886, by Mr. J. H. Coope, of the Ben Lomond Vineyard, of Santa Cruz County, which is said to handle redwood trees up to four feet in diameter successfully. It consists of a portable engine and a "puller," which is a wind-

lass operated by steam, from which a wire cable is carried to the tree which is to be pulled down. The following account* is pronounced correct by Mr. Coope:—

A strong chain is put around the tree at a distance above the ground proportioned to its diameter in such a way as to give necessary leverage. This is a nice point and one requiring experience and judgment, since a mistake may cause the trunk to break above the roots. The immensely strong hook at the end of the cable is attached to this chain and the word given to the man at the engine, who adjusts the machinery of the "puller" so that the cable is slowly wound upon the reel. The coil begins to grow taut, the great bole of the tree seems to shiver through its entire length, a dull creak and strain are heard as the roots begin to be torn from the earth. So perfectly is the machinery adjusted that the tree may be instantly stopped at any point of its descent. Two chains are used, a second tree being prepared while the first is falling, that no time may be lost. The cable is detached from the falling tree and a horse draws it from amid the *débris* of fallen foliage to the next victim. The extraction of roots by this method of pulling is said to be very complete and the earth loosened to a considerable depth.

The powerful traction engines manufactured by Daniel Best, of San Leandro, for hauling combined harvesters and steam plows, have also been very successfully used for the removal of large trees in land clearing.



THE CALIFORNIA STUMP PULLER.

HORSE-POWER STUMP PULLERS.—The use of horse-power devices for tree felling and stump extraction has increased considerably of late. Some are of the same styles used in the Mississippi Valley, but the one which has achieved the best results is a local invention called the "California Stump Puller." An outline drawing given herewith shows the chief features of the machine and it is represented as pulling the stump (Fig. 1) and as pulling down the tree using stump (Fig. 2) as an anchor, so

* Santa Cruz *Courier Item*, March 19, 1887.

that the tree shall not fall upon the machine, as it would do if pulled directly toward the capstan. In the engraving one of the braces of the frame is removed so as to show the capstan and its attachments. The "California Stump Puller" is manufactured in San Francisco by Mr. George Harvey, the patentee. He furnishes the following outline of his claims for the machine and cites abundant testimony in support of them:—

The machine will, in two minutes from the time the horse is started, pull a stump or tree which but few men would be capable of grubbing in half a day; also two men and a horse are capable of pulling more stumps or trees in a day than thirty such men can grub by the old hand method. The machine with one block multiplies the power of the horse operating it seventy-two times. It will pull green stumps up to fifteen inches diameter and trees twenty inches. I have letters from different parties saying that the machine would do more than I claimed for it, and reports have been made to me of the machine pulling green trees forty inches in diameter with the power named. In clearing land with the machine when the soil is in good condition all roots are entirely removed, the ground is broken up, and the plow meets with no obstructions. No large holes are left in the ground, as in hand grubbing, for the most of the soil falls back to its place as the stump is pulled. Because of the speed of work with this machine land cleared in the winter can be seeded or planted in time to insure a crop the same season. The cost compared to hand grubbing is very small and when the land is being prepared for fruit trees and vines the injury resulting from the decaying roots of forest trees is avoided.

THE USE OF POWDER.—Another means for the removal both of stumps and of growing trees which has come into quite wide use during the last few years, is the high explosives invented for the use of the miners. The skillful employment of dynamite, Judson powder, Hercules powder, or Vigorit powder, has vastly cheapened the clearing of lands where either large trees or stumps have to be removed. For example, the usual rate paid on Howell Mountain, in Napa County, for grubbing out black oak stumps was from $1.00 to $4.00, and for pine from $2.00 to $6.00, according to size. An expert blew out one hundred and thirty-two stumps for $128, or less than $1.00 each, and some were so large that it would take several days' grubbing to get them out by the old method.* During the last two or three years the use of powder for this purpose has become so common that it is no longer experimental. The experience of the blasters is that there is not more danger connected with the operation than in handling ordinary firearms, and possibly less. The manufacturers of these explosives furnish full printed instructions as to the safe and effective use of them, but it will be worth while in this connection to give a few indications of the nature of the operation. Either in the case of a stump or a tree it is necessary to get the charge of powder as nearly under the center as possible. Some have used inch-and-a-half augers lengthened out to about three feet, and have bored into the tap-

*John Mavity, in *Pacific Rural Press*, March 10, 1884.

root of the tree or stump. This is quite a laborious operation and seems from the experience of others to be unnecessary. If the charge is placed well under and alongside the taproot, it answers just as well. For this purpose a hole can be made with a bar. If the tree or stump is very large, say upwards of six or eight feet in diameter, it is advisable to slip a cartridge of powder into the end of the hole made with the bar and explode it. This hollows out a cavity right under the center of the tree, in which the larger amount of the explosive can be placed. With small or ordinary-sized trees this is not necessary, as excavation enough can be easily made.

There are various ways of inserting the charge of powder. One is as follows: Put the Judson powder in a bag. The advantage of having the powder in a bag is that the hole has to be made between the roots, and deviates frequently from a straight course by the irregularity of the roots. A bag can easily be pressed with the hands into such hole to reach the center under the tree or stump, which could not be done when the powder is in a box. After having put a small primer of Giant powder, with a fuse and a cap attached, through a hole into the box or bag of Judson powder, then tamp the hole with dirt; when this is done, light the fuse and get out of the way.

The amount of explosive is regulated according to the size of the obstacle to be removed. All this can be learned from the agents in San Francisco, and they often send an expert to start the work and give instruction to workmen if there is much work to be done. It has been estimated that the cost of handling trees and stumps with explosives is less than one-fifth that by hand grubbing, and the ratio of saving increases as the trees are larger, as powder is cheaper than muscle. The blasting method has superseded most of the stump-pulling machines even for handling the smaller stumps. Anything too large to be twisted out with a lever and chain or "snaked" out by a direct pull with the team is touched up with a charge of powder.

REMOVING SHRUBS AND BRUSH.

In the case of removing shrubs of a somewhat tall growth, the top is made to help out the roots. This is done either with a good strong inch rope or a chain. Two methods as practiced on the foot-hills of the Sierra Nevada are described as follows:—

Chaparral can be pulled up by the roots. To do this requires two men and a pair of horses, and two chains, each ten or twelve feet long. A chain should be placed around the bush some distance above the ground to give leverage. If the bush is not removed at the first pull, start the horses in the opposite direction. While the driver is unfastening the chain from the chaparral, the second man can place the other chain around another bush, and the one who gets through his work first should

at once assist the other. In this way the horses are kept in constant employment, and neither of the men need lose a moment's time. This work should be done when the ground is thoroughly wet.*

After trying several methods with the chamisal and "blue brush," such as a hook, also blocks and tackles, both proved a failure, the hook because it had to be hitched too close to the ground, thus gaining no purchase, but a dead pull on the horses. The blocks and tackle were too slow work altogether, so were discarded. The best method I have found is to take a horse or a span, with an inch rope forty feet long, having a large hook on one end, the other end looped with a bow-line so that it can be hitched and unhitched without trouble from the stretcher. Now take the rope, when the ground is soft after a heavy rain; place it around the brush, as high up as it will stay without slipping over the top; hitch on and pull out. You may have to go back and cut a few roots to assist.†

Where manzanita grows somewhat upright, as it does on the hills north of the bay, the same methods of extraction can be employed with it, first slashing off enough to allow adjusting the rope or chain a few feet above the ground. Where it grows lower, as, for example, on the hills of Santa Clara, the manzanita brush is gone over with a roller so as to break it down, and then the land is burned over. The roller should be of the ordinary farm pattern, but rigged with a tiller (header fashion) so that the horses can push the roller and walk over the flattened brush. The only object of the rolling is to smash the brush down so that it will burn readily. When the brush is got rid of in this way, the plow is trusted to get rid of the roots. The plow should be of the pattern known as "prairie breaker" without coulter. Horses should be shod with a plate of sheet iron between the shoe and hoof to prevent snagging, and not less than four of them used. Much of the Santa Clara County vine belt was cleared in that way. Of course this method only answers for the lighter-rooted growths; tough-rooted chaparral, oak, holly, etc., must be grubbed out, unless the roots are snaked out by the tops, as has been described.

In spite of all appliances there is much straightforward, hard work to be done in clearing land, and the case described below probably better represents most undertakings of its kind than anything else that can be written:—

I have a side-hill that is facing north. It was all covered with underbrush. It was so thick that stock could not pass through it. There were buckeyes, young oak trees, laurel stumps and oak stumps. I hired a man and put him to work by the day, at $1.25 and board. I bought two good mattocks, and we started in at the foot of the hill and commenced to clear off. The brush we burned as we went along, and the stumps we dug around and chopped into fire-wood, and I got a piece cleaned off. I started in at the foot of the hill and plowed one way, going back empty. I have not seen any side-hill plows fit for this kind of work, as the plow has to cut roots all the time. It wants a good sharp share.‡

*P. W. Butler, Penryn.
†Thos. Raymond, Coulterville.
‡C. Dell, Napa.

MARKETABLE PRODUCTS OF CLEARING.

Whether any money can be made from the results of clearing depends altogether upon local markets for wood and charcoal and the cost of transportation to them. From clearings near large towns enough can be sometimes had to pay for the work and hauling, and along railways wood can be often shipped with profit. This can only be learned by local inquiries.

CHARCOAL BURNING.—Charcoal can usually be sold to advantage. The price in San Francisco ranges from forty-five to sixty cents per sack holding about two bushels. There is also market for charcoal in interior towns, especially where Chinamen are found in numbers. Charcoal is made from most kinds of wood, and sometimes stumps and large roots are charred. A simple process of charcoal burning is given by an experienced burner as follows:*

To burn a pit of charcoal, the prime necessity is to perform the process of combustion with the least possible contact with air. Select a suitable place not too far from the dwelling, because the operation must be watched from time to time by night as well as by day. It is not necessary to dig much of a "pit" in the ground. Choose hard limbs of pine, spruce, or whatever wood is most available of that kind. Dry, dead limbs, if not decayed, take for choice. Set them up wigwam fashion, close together, fitting them as well as they will allow, the apex forming the chimney. Be careful to keep that chimney free, because the fire should be there applied to brisk "kindling" as far down as possible. Build round and round, taking the precaution to lay three or four straight pieces, three or four inches in diameter, along the ground from the outside to the center. These may have to be withdrawn to promote the draught.

The wood all being in place, it is now required to cover it thoroughly. In the absence of turf or sods, it must be thatched with leafy green boughs, or anything that will prevent the earth or dirt that is now heaped on from running through. Pack this soil covering carefully, exclude air as far as possible, excepting when the port-holes referred to near the ground are needed. The direction of the wind will determine which ones are to be opened. When the fire—after a few hours, more or less, according to the materials—has got a good hold, close also the chimney. Visit the pit regularly, night and day; lessen or increase the draught as may seem needed; and in a week or ten days the two or three cords of wood should be turned into good hard coal. When uncovered, water or dirt should be thrown upon coal that is too lively when spread out on the ground.

FIRE-WOOD IN SAN FRANCISCO.—Wood for the San Francisco market should be in four-foot lengths. A range of prices for the different kinds is about as follows, varying much, however, according to coal supply and prices: Peeled or tan-bark oak, $9.00 to $11; black or live oak and white oak, $7.00 to $8.50; pine or fir, $8.00 to $10; redwood, $7.00 to $8.00; tan-bark, from the tan-bark oak, $17 to $20 per cord. The cost of transportation by rail is sometimes from $2.00 to $4.00 per cord for a distance not exceeding one hundred miles. These figures are only mentioned to give a general idea. Of course no one

*W. B. M., in *Pacific Rural Press*, February 20, 1887.

will make definite calculation without securing data at the time and for the locality of the operation.

CUTTING TO KILL BRUSH.

Just when to cut to kill depends both upon the character of the growth and of the season. Dr. J. W. Gally says:* "It all depends, with the leaf shedders, somewhat on soil and altitude or nature of climate. Now, in Pajaro Valley, which is cool and moist, I have seen willow, sycamore, cottonwood, box-elder, maple, and 'grub' oak die out from being cut down flat with the ground, or to two or three inches below the surface, in late July or early August. But even that will depend somewhat on the kind of season; if in a late, cold, wet season, you cut a little later."

Mr. C. P. Scranton, of Lake County, gives a slightly different time. He says:† "For the evergreen oaks and other evergreen brush, the time is late in the fall, just before the coldest weather sets in in November or December. The 'grubs,' or oaks that shed their leaves, have to be treated entirely different. Their time is in spring or early summer, at their most vigorous growth. Suddenly deprived of their leaves, the stump and roots are overcharged with sap, some kind of fermentation sets in, and I have seen the timber mold and commence to decay in a few days when it was very warm weather." In the eastern hills of Fresno County best success is had with cutting brush in August. More experience and observation are needed to enable one to generalize safely, but one conclusion seems to be that with deciduous growths the best time to cut is when they have just made their most vigorous growth, and this is in the summer—but the month to be chosen for the work will depend upon the location, though August is generally selected as the best time. Theoretically, the reason for the choice of this time for cutting is that most deciduous trees and bushes have then completed their annual growth, and have their terminal buds definitely and fully formed. When this has occurred, it seems the plant has in a measure exhausted itself, in its effort at reproduction or adding to its growth, yet still supplies a large quantity of sap, for the consumption of the leaves and solidifying the new wood. If at this time we deprive the roots of the assistance of the foliage in the elaboration of the sap, the result appears to be a congestion of the sap in the roots, for want of circulation, and this almost always kills them entirely. To strip a tree of every leaf at that season is almost as certain to kill it as if the whole

**Pacific Rural Press*, March 24, 1888.
†*Loc. Cit.*, March 10, 1888.

top were cut off at the ground, while, if deferred one month later, few trees would be materially injured.

In the case of evergreens, as stated by Mr. Scranton, the cutting should be just before the coldest weather, in which they are the nearest dormant, the length of time before they can put leaves out again kills them. Evergreens, however, differ much in tenacity of life, for while most kinds are easily killed, the California redwood will endure almost any abuse with ax or fire and still spring up repeatedly and persistently for years.

THE USE OF SHEEP ON SPROUTS.—On sprouting brush there is, perhaps, no cheaper or more effective means of repression than sheep and goats. They are used instead of grubbing, if one can wait, for by their persistent cutting down of growth, the small stumps and roots will decay enough in a year or two to be plowed out with a strong team and plow.

BURNING OF THE DÉBRIS.

However the trees and underbrush may be wrenched from the soil, fire is the final clearer. Where trees are to be worked up into fire-wood, it should be done as soon as they are felled, for the work is much less than after they become dry and hard. If it is not designed to break the land the first winter, the wood is left to season and it becomes lighter and easier to handle. The brush and roots, if no use is to be made of them, can be left to lie on the clearing to dry out during the following summer, and after the first rains of the following fall the whole area can be burned over. Such stumps as do not burn with the brush must be gathered in piles and re-fired. Burning before the first rain should not be attempted, unless it be in exceptional situations, because of the danger of communicating fire to the surrounding country, which is a standing danger in our dry climate. After the rain, then, clean up the ground perfectly.

FIRST CROP ON A CLEARING.—It is the opinion of some clearers in the redwood region that the soil is not fit for fruit trees the first year after the original growth is removed, and they grow a field crop the first year. They claim that peas are the best corrective of "redwood poisoning," and fortunately in the upper redwood district they have a climate well suited to the pea. Whether their theory is right or not, their practice is of advantage, because they get a better cultivation and aeration of the soil, and kill out much of the sprouting from the old roots, which is usually quite persistent in the moister parts of the State. Usually the tree and vine planter is in such haste to realize from his labor that he does not allow the first year to go for any side issue.

SURFACE LEVELING AND DRAINING.

There is often occasion to clear the land of stone and rocks. The latter should be blasted out of the way so that the land may be clear for the plow and cultivator. Once in a while one will come upon a stone wall inclosing an orchard in this State, as trim and true a wall as the most thrifty New England farmer can boast, but walls are not common. Our valley orchard lands are, as a rule, naturally as free from stone as they are from underbrush, but on the hills it is different. Probably the best way to dispose of much of the stone is to dig trenches in the natural water runs, put in stone, cover with small brush, and then with soil deep enough so the plow will not reach the brush. This disposes of the stone for all time, and at the same time helps to drain the soil. Concerning other treatment of the land after the rubbish is removed, P. W. Butler writes as follows:—

When runs are wide, lateral ditches should be cut extending entirely through the moist areas. The rocks in the ditches should have a sufficient covering to place them below the reach of the plow. If during the rainy season a run is likely to have more water than can be conveyed properly through a covered trench, it should be left open and graded so that a team can cross it, and for fifteen feet on each side sow to red-top. In this way the land can be utilized that would be worthless for trees, and the red-top, that can be grown at a profit, will take the place of unsightly weeds, that would otherwise grow at the point that cannot be cultivated.

To distribute work more evenly through the first year buildings can be erected, a well dug, and the trenching done in the dry season, while all the grubbing, leveling, plowing and planting must be done during the time when the ground is wet. The following season, as soon as the ground is sufficiently moistened, it should be well leveled. All depressions where water would stand should be filled, and all flat places should be graded until water will readily flow off, and not be retained so near the surface of the ground as to cause it to become soured. This leveling can be best done by one man and a pair of horses. Plow the adjacent elevated land and scrape into the places to be filled.

The land is now ready for plowing and should be done thoroughly, subsoiling to as great a depth as the removal of the stumps will allow. It is now well to go over the ground again with the scraper and level all the most elevated points so they can be reached by water in irrigating. Then cross-plow as deeply as possible without again subsoiling, harrow and drag, and the ground will be ready to plant.

Mr. Butler writes with reference to the foot-hills of the Sierra Nevada, where irrigation must be practiced. Where irrigation is not used, leveling, or rather grading, is unnecessary, but it is often quite as necessary to arrange for drainage so that there may be no depressions which do not have an outlet for the surplus water. The life of the trees and the convenience of the planter demand this

CHAPTER VIII.

THE NURSERY.

CALIFORNIA nursery stock is unrivaled in growth, health, and vigor. This is the verdict of all visiting horticulturists, and was formally declared by the victory of California tree growers at the New Orleans World's Fair, in 1885, where the highest premiums were awarded to Californians in nearly all classes in which they exhibited.*

The quality of the trees which can be purchased at our nurseries, and the very low rates at which they have been sold during the last few years, makes it little worth while for the orchard planter to try to grow his own trees. In fact, the investment called for to secure a good assortment of well-grown trees will be one of the best which the orchard planter can make. The professional grower, if he is honest and enterprising, can give the purchaser the advantage of his experience and skill in the choice of stocks suited to his soil, varieties of fruit adapted to his situation, and be of assistance to him in other ways connected with his enterprise; and such helps to an inexperienced planter or to a new-comer are very valuable. There may be, however, some reader who is distant from established nurseries, or possessed of limited means, who may like to use his spare time in growing his own trees, and to such some suggestions are offered. There will, however, be very much which can only be learned by actual experience.

In the selection of location for a commercial nursery there are matters involved which it is not proposed to discuss. Attention will be paid rather to matters connected with what may be called a farm nursery. The first point will be the selection of a small piece of ground which offers proper soil, exposure, and, in some parts of the State, facilities for irrigation.

PROPER SOIL FOR NURSERY.

The soil should be a mellow loam, easy of cultivation and

* John Rock, San Jose, took first premiums on the following nursery stock: Apples, almonds, apricots, cherries, figs, mulberries, olives, pears, persimmons, foreign plums, walnuts, chestnuts, and smaller collection of peach trees. Leonard Coates, of Napa, won the first award for the largest collection of peach trees. Report "American Horticultural Society," 1885, p. 226. A full list of Californians exhibiting nursery stock can be found in *Pacific Rural Press*, March 7, 1885. Several were prevented from competition for awards because their exhibits did not come under the rules for collections.

not disposed to crust and crack. In all respects what one would choose as a rich, kind garden soil will answer well for the nursery. The soil should be moist, but thoroughly drained, either naturally or artificially, for time and labor will be largely wasted on a water-logged soil. In this respect a soil which might yield fair crops of some shallow-rooting vegetables would not always be suitable for the young trees, which, to do well, must have favorable conditions to send the roots to considerable depth. Good spots are often found in the rich loam along the banks of creeks, as in such situations one finds generally a deep alluvium, well drained by the creek. But such situations, if liable to overflow, should be rejected because standing water is not good for trees, and because the soil will be apt to be soaked with water and inaccessible just at the time when the trees should be lifted for transplanting to orchard.

It is not always possible to find an ideal nursery spot on every ranch, but still trees may be well grown on less favorable places if attention is given to correcting natural defects. For example, if the soil be naturally heavy, it may be improved somewhat by repeated plowing and cultivation during the year before starting the trees. If it be an adobe, its mechanical condition may be greatly improved by the application of a top dressing of lime at the rate of six hundred to one thousand pounds of lime to the acre. For this purpose "lime waste," which contains both lime and wood ashes, can be had cheaply at the kilns. Old plaster which may have been left from house repairs is excellent. Even builders' lime would not be very expensive, for but little would be required for so small a plot of land as a farm nursery would need to cover. The lime will increase the amount of plant food in a heavy soil as well as render it more friable. Another way in which a small area of heavy soil may be improved is by the addition of sand. A few loads of sand, if it can be had near by, will remove the tendency to crack, and will act as mulch to prevent evaporation of moisture. If the soil be very loose and subject to too rapid drying out, the remedy will be moderate irrigation during the summer, but it should cease early enough to allow the young trees to ripen their wood before the frosts of autumn. Mulches of various light, fine materials, rotted straw and the like, may be used to advantage among the young seedlings in preventing drying out of the soil, if the plot is to be hand-worked, but such materials are apt to be in the way of neat, thorough work with the horse. A mulch of sand, if available, is not open to this objection.

In choosing soil for a nursery, a piece of land which has been in cultivation for garden or field crops is to be preferred

over a newly-cleared piece. It is often the case that soil from which old stumps or shoots have recently been removed has become soured from the processes of decay in the dead wood. Although the deposit of humus from decay of woody fiber tends to enrich the soil, afterwards certain acids are formed if the land lies without cultivation. These are not favorable to the growth of young roots, and a crop to which as much time is given as a crop of young trees, should not be placed upon it. This evil quality in the soil is removed by cultivation and aeration, or may be corrected by the application of lime. This state of soil is most complained of in connection with old stumps and roots of oaks in the valleys.

SITUATION AND EXPOSURE.—As to situation of the piece chosen for nursery, in addition to what has already been suggested, it may be remarked that warmth in the soil is necessary to a good growth, and a good year's growth is essential to the production of a satisfactory tree. Drainage contributes notably to the warmth of the soil. Exposure is also of importance. Plenty of sunshine and protection from cold winds are to be secured. Sometimes a little elevation is desirable. It would be a serious mistake to seek moist, low land if the piece lies at the bottom of a little valley or depression where the cold air settles during the night and frosts are frequent. In such cases choose higher ground. Of course, in broad, open valleys there is not this objection, for such seasonable frosts as may be expected there are not injurious to deciduous nursery stock. The greatest nurseries in the State are in the open valleys, not on the lowest ground, however, in all cases, but on what would be called good, rich, valley land. There are, however, situations in the thermal belts in which the temperature does not fall low enough to check growth of deciduous trees and cause the leaves to drop. In such cases it has been found desirable to select lower and colder ground for the nursery of deciduous trees.

PREPARATION OF NURSERY GROUND.—The best preparation for nursery ground is the growth, the previous season, of a hoed crop. This will secure frequent working of the soil, thorough pulverization of the clods, etc. The produce of the hoed crop should thus pay the cost of putting the land in good condition, at least. Where the retention of moisture is an object, as it really is in some parts of the State where the annual rainfall is sometimes small and no facilities for irrigation provided, it will perhaps pay better in the end to keep the land in bare fallow during the previous summer; but there must be frequent and thorough cultivation, keeping the surface always mellow, or

more moisture will be lost by evaporation than a hoed crop would require for its growth. Properly cultivated fallow soil will have moisture within a few inches of the surface, while unworked soil adjoining will be baked hard and dry to a depth of feet. During the winter immediately preceding planting, the green stuff should be allowed to grow for a time, but should be plowed under before it gets high enough to interfere with perfect turning of smooth furrows. The decay of this green crop is of advantage to the soil. Another plowing in the spring, and a thorough harrowing, will leave the ground in good condition to receive the pits or root grafts as the case may be. In this plowing for nursery there should be deep work done and subsoiling, as will be more fully set forth under the head of preparing land for orchard, to which the reader is referred.

GROWTH OF SEEDLINGS FOR THE NURSERY.

The two chief ways of producing fruit trees are, first, from seedlings grown on the spot; second, from buds and root grafts upon stock imported from the East or from abroad. First, as to the growth of seedlings:—

It is usual to take seeds from sources where they can be collected with the least trouble. Apple seeds are washed out from the pomace of the cider press; apples and pears, from the coring and peelings of canneries and drying establishments; pits of the stone fruits are derived from the same source. Supplies can usually be purchased from such establishments at a moderate cost. The trouble is that from such supplies one is apt to get seeds and pits from all varieties, possessing different degrees of health and vigor. There is just as much to be gained from selecting the seed from which to grow good strong stocks for fruit trees as there is in selecting good garden or field seed. One can generally get good peach pits, for it is easy to have the order filled when the cannery is running on yellow Crawford, which is an excellent parentage for peach trees, and yet some claim much preference for pits from vigorous seedling trees and make extra efforts to secure them. Wherever it is possible, and if one is only to produce a small lot of trees it is practicable, to select from the fruit the pips for planting. In the case of the apple, the late John Lewelling claimed that he had satisfied himself that trees grown from the seed of Rawle's Janet or the Golden Russet, had roots which would be free from the woolly aphis, while roots grown from seed promiscuously obtained would be infested. But not only is there great difference in the strength of different varieties, but individual trees vary greatly. If one is taking seed from an old orchard to start his nursery

with, he can take pains to get his seed from his strongest trees, and thus get that which is probably best adapted to his locality.

APPLE AND PEAR SEEDLINGS.—For a small lot of apple and pear trees the seed can be best sown in boxes. Keep the seed moderately moist from the time it is taken from the fruit until sowing. Fill the boxes, which should be three or four inches deep, with good garden mold, cover the seed about half an inch, and then cover the soil lightly with chaff or fine straw to prevent the surface from drying out. Be sure that the boxes have cracks or holes in the bottom for drainage, and the whole is kept moist but not wet. When the seedlings have grown to the height of three inches, they can be set out in the nursery rows as one would set out cabbage plants.

CHERRY SEEDLINGS.—There are different ways of handling pits of stone fruits to prepare them for setting out in open ground, which will be described. The cherry is grown from pits of two wild varieties; one is commonly called the "Black Mazzard." It is the common wild cherry of the East, and is the original type of what are known as the Heart and Bigarreau types of cherries. The other is the "Mahaleb," which is used at the East for dwarfing, and also in situations where it thrives better than the Mazzard, as it is hardier stock. In this State the Mahaleb does not seem to have such a dwarfing effect as there; trees on that stock in this State over twenty-five years old are twenty-five inches in diameter of trunk. The Mahaleb, however, ripens its wood earlier, and for this reason may be valuable in the colder parts of the State. The Mazzard is almost universally used in this State. Cherry stones are sometimes taken from the fully-ripened fruit, dried for two or three days, the stones cracked carefully and planted at once in good soil and kept properly moist. They will germinate soon and make a growth of a foot or so the first season. Such stocks are taken up for grafting in the winter and set out in nursery row the next spring. A better way of treating cherry is that given by W. W. Smith, of Vacaville, at a meeting of the State Horticultural Society, as follows:—

The fruit of the Mazzard should be allowed to get perfectly ripe on the tree, then gathered and let lie in a heap for three or four days, so that they may be partially or wholly freed from the pulp by washing them in water. They should then be spread out in the shade and stirred frequently for about twenty-four hours. This will give the outside of the pit time to dry sufficiently to prevent molding, while the kernel itself will remain fresh and green. They should then be placed in moist (not wet) sand and kept so until the rains set in in the fall, when they can be planted in drills, in good, rich, mellow soil prepared the previous spring and kept clean of weeds through the summer, ready for the purpose. They should never be allowed to get perfectly dry; and the reason for it is that we have but little or no freezing

and thawing weather in this country to cause the pits to open; but if they are kept constantly moist it answers the same purpose as freezing. The seeds of the Mahaleb cherry will sprout with less difficulty, but the same rules for keeping the Mazzards will apply to them.

THE LARGER STONE FRUITS.—In handling pits of the larger stone fruits the chief requisite is to prevent drying and great hardening of the pit. Some plant in the fall and trust to natural conditions to start the seedling in the spring, but this interferes with the cultivation of the ground, and leaves the seedling to grow in soil which has perhaps been puddled by heavy winter rains. There must also be much hand work done to clear the rows from weeds. It is much better to keep the pits from drying by covering with sand moderately moist, hasten the sprouting by appropriate treatment towards spring, and then plant out in thoroughly prepared soil, and they will make a satisfactory growth. The following method by D. J. Parmele, of Vacaville, has given good results:—

Keep the pits out of the sun until the rains commence in the fall, then put them into a box about a foot deep, and scatter sand or fine earth through them, putting about two inches on top, and place them under the eaves of a building on the south side, where they will get well soaked every time it rains. If there should be a long dry spell during the winter, water them a little. The warm and cold of day and night, and wet and dry of rain and shine, are what cause the pits to open, although the sprouting favors it. About March they will open and sprout. Then take a plow and open a deep furrow in loose, mellow ground, and, with a hoe, pull about two-thirds of the dirt back into the furrow, breaking the clods, and making it fine, the same as you would if you expected to plant onion seed there. Drop the sprouted pits in straight line, and cover two inches. On account of the extra work in preparing the ground, the trees will be large enough to bud in July.

Another way is to spread out the pits on a smooth piece of ground and cover with sacks, and over these a layer of straw three or four inches thick to retain moisture. The pits may be planted out as soon as they crack open, although no harm will be done if they are allowed to lie until the sprouts are well out.

Another method which has been especially recommended for treatment for almonds is the following: Lay boards upon the ground and cover them with an inch of sand; spread on this a layer of almonds and then another inch of sand, and so on. Keep the pile wet and in three weeks of warm weather they will burst open. Plant in drills one inch deep and put over them a light coat of rotten straw.

If from any cause the pits have become quite dry, they should be soaked in water two or three days before planting. In this way imported myrobolan pits may be made to sprout, though even with such treatment many will refuse to germinate. For this reason imported seedlings are preferred to pits.

NUT TREE SEEDLINGS.—In growing nut tree seedlings

much the same methods are followed as with pits of stone fruits. There are methods described in detail by California growers which should be given. As has been said, the nuts may be planted at any time after ripening, in the milder parts of the State, if the grower will undertake the greater care and cultivation. On some light soils where the rainfall is not excessive, this is not much trouble. Felix Gillet, of Nevada City, the well-known propagator of improved varieties of nut trees, gives this as his method:—

The nuts may be planted as soon as gathered, though here in Nevada City it is too cold to plant them in the fall, for the frost in winter would surely lift the nuts right out of the ground. This is the way I employ in keeping and sprouting walnuts: I throw into the bottom of a box one inch deep of sand, then a layer of nuts; put in another inch of sand, and another layer of nuts, and so on to one or two inches from the top. Then water well with a sprinkler and water again during the winter whenever the sand gets too dry. The sand has to be pretty well saturated with water, especially from the 1st of January down to planting-time, which is in February, March, or April, according to localities. The latter part of March or first week in April is best for Nevada City. The nuts are planted in drills and to a depth of two to three inches.

In propagating chestnuts it is always better to select for seed the largest, finest, and healthiest nuts; in the fall or beginning of winter the nuts have to be planted in a box of damp sand, by layers, the box being kept in a cellar. The nuts may be planted, too, in a hole in the open ground, a layer of chestnut leaves being first thrown in the bottom of the hole, on top of that a layer of nuts, then another layer of leaves, and so on to the top, which has to be properly covered with two or three inches of earth so as to prevent the frost injuring the nuts. In February or March, according to location, the nuts are taken out and planted in drills to a depth of three to four inches; less for smaller seed like American chestnuts.

In planting out pits or nuts, if they have sprouted when taken out of the sand or hole where they have been kept during the winter, as is most generally the case, they must be planted with the sprout up or sideways, but never the small end down. So it is with walnuts, almonds, and filberts, and also the pits of peaches, apricots, and plums. This point is quite important with chestnuts and walnuts, so as to obtain straight stocks and shapely roots; then when the nuts are planted wrong, upside down, the sprout is liable to remain buried in the ground, where it will finally rot.

IMPORTED SEEDLINGS.

A very large proportion of some kinds of fruit trees produced in this State are worked upon imported seedling stocks. Almost all the cherries, and it is estimated that nine-tenths of the pears and one-third of the apples, are thus grown. These stocks are cheap, convenient to handle, and are therefore popular. It is easy enough to grow peach, almond, and apricot seedlings, but small seeds, like apple and pear, often do not show up well in the spring, especially if the soil is of a kind that crusts over with rain and sunshine. Therefore our nurserymen import

these seedlings in the winter, plant them out, as has already been described, and bud in the following summer, grafting the next spring where the buds fail. If the seedlings are large when received, they are often root-grafted at once, and then one summer in the nursery gives a tree suitable for planting out. It is claimed for the French pear seedlings that they hold their leaves better in the summer than Eastern seedlings, and imported apple seedlings are less likely to be affected by woolly aphis. These stocks are of better budding size during their first summer than California seedlings, which are apt to overgrow.

To succeed with cherry seeds requires special treatment, as has already been described, and the nurseryman usually finds it cheaper to buy his stocks.

Myrobolan plum seedlings are also imported to a large extent. This stock is rapidly advancing in favor for plums and prunes, and, in some situations, for the apricot; but some growers report a very marked dwarfing effect on the apricot, and do not approve its use. It has also been claimed to be fitted for the peach, but when a plum root is needed for the peach the St. Julien is better. The Myrobolan stocks used in this State were largely from cuttings, and their value as compared with seedlings was a matter of some contention. It is now pretty definitely settled that the propagation from cuttings produces inferior trees, and there is strong suspicion that they are liable to root diseases. A fuller discussion of stocks will be given later in connection with the propagation of each kind of fruit.

FRUIT TREES FROM CUTTINGS.—It is feasible to grow a number of kinds of fruit trees from cuttings, but it is not desirable in many cases to do it. Trees grown from a graft or bud in a seedling root are much better. The root system of a seedling is naturally stronger and more symmetrical. The roots from a cutting start out at the bottom and spread out horizontally and irregularly. This style of a root system is expressively named "duck-foot roots," and they do not give the tree a deep, strong hold on the soil. Trees can, however, be multiplied very fast from cuttings. Notable instances of this are the Myrobolan plum and the Leconte pear. Cuttings of deciduous trees should be taken from well-matured wood of the previous season's growth, and planted in rows and in well-prepared soil, as has already been described for the sowing of fruit-tree seeds. The cuttings should be taken before the sap begins running in the winter. A cutting about ten inches long, two-thirds of its length buried in the ground, will answer. Small wood is better than

large, though, of course, the extreme ends of twigs should be rejected usually. Cultivation of cuttings is the same as that of seedlings, and budding, when the cuttings are to be used as stocks, is also governed by the same rules.

The orange and lemon can be grown from cuttings, but the work is done at a different season, and requires different treatment. Cut from wood one or two years old; set in open ground of partial shade and give plenty of water (dry ground is death to their tender roots). Plant out in the summer months. Cuttings started in the warm weather and given partial shade and plenty of irrigation are very apt to succeed. A piece of well-drained soil is essential. This method of growing these fruits is not, however, in wide use or favor.

The propagation of the olive and the fig from cuttings will be considered in the chapters on those fruits.

PLANTING OUT IN NURSERY.

For planting out in nursery, the term "spring" is given at the proper time, but in California it must be remembered that spring is not any definite division of the year. "Spring weather" comes from the first of February to the first of May, according to the latitude or elevation or exposure resulting from local topography. Cherries may be ripe in Vaca Valley before fruit trees put out leaves in Modoc County; and between these extremes there are advents of spring in other places according to the situation. These facts are more fully set forth in the chapter on climate. Spring must be detected in the behavior of vegetation and not by the calendar. When the tree buds swell and the leaves appear, spring has come for that locality. But whether one can plant his nursery then or not will depend upon the character of the soil and the condition of the rainfall for that season. This varies much from year to year. As a rule, however, in most parts where fruit is grown at present in large quantities, the heavy cold rains will be over by the first of February, and then nursery operations can commence if the soil is in good condition. If not, the planter must wait until the soil is dry enough to work nicely. There will, of course, be heavy rains after the first of February; but they will not do more injury than to require cultivation to loosen the soil, if the nursery ground is well situated for drainage, and if it is not it should not be used for this purpose.

Supposing the ground has been deeply plowed and thoroughly harrowed, as has been already described, the laying out of the ground is the next operation. Everything should be done with a view to the use of the horse in cultivation. The rows

should be laid out as straight as possible. Some use a plow furrow; some an arrangement like a corn-marker, with two cultivator teeth set four feet apart; some stretch a line, to get the pits or root grafts as true to it as possible, and some trust to the furrow for straightness. No rule can be laid down for means to be employed; the result must depend upon the eye and skill of the individual. Some people can hardly shoot a straight line with a gun. Each must do the best he can in this respect.

There is difference in practice as to distance between the rows in nursery. The usual distance is four feet, but others claim that it is better to make the rows six feet apart, especially where no irrigation is practiced, as this gives the young trees more room, and if the ground is kept thoroughly cultivated, as it should be, it gives the roots a greater supply of moisture to draw upon. In growing a small lot of trees, where there is plenty of land, it is, of course, desirable to give them every advantage in the way of facilities for growth.

At the ends of the rows spaces of about twelve feet should be left as turning-ground for the horse when cultivating, and as a roadway. The length of nursery rows depends upon the taste of the grower. It is convenient to have alleys wide enough for a horse and cart at intervals of one hundred to three hundred feet; but in small nurseries the headlands would probably give all the access required.

The depth for planting seeds and pits must be regulated by the size of the seed and the character of the soil, as is always laid down by the authorities, and in this State another condition must be made, and that is the climate or weather conditions prevailing in the locality. Where the rainfall is generally light and the soil loose, seed must be planted deeper than where good spring showers are to be expected. In fine soils seeds must be planted shallower than in coarse, even with the same rainfall. Judgment and experience must dictate in this matter, and if a man has no experience, he is pretty apt to get it.

During the spring months the cultivator must be used as often as may be required to keep the weeds from getting too high, or the soil from becoming too densely packed by heavy rains, but the ground should never be worked when too wet. It requires some watchfulness and promptitude to use the cultivator just at the right time.

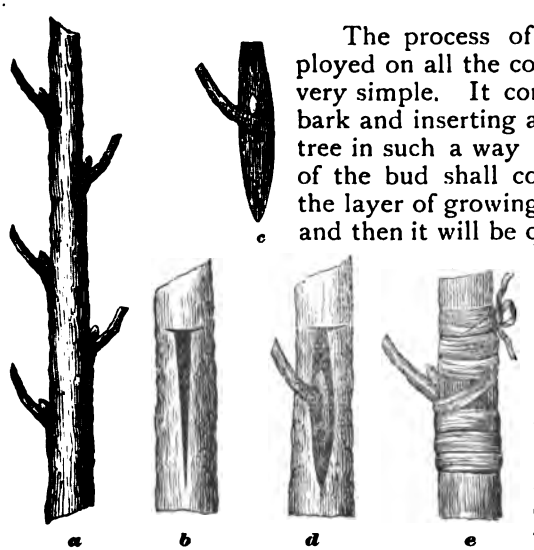
In parts of the State where the rainfall is adequate, cultivation thorough, the soil sufficiently retentive, and atmospheric conditions favorable, the seedling will make its growth without irrigation, and many nurseries are on ground not provided at all with irrigation facilities. In other parts of the State irriga-

tion is necessary. Water should be applied sparingly, and yet enough to keep the seedling in healthy, growing condition. This is shown by the leaves, which should not droop or curl. Excessive irrigation should be guarded against, because a soft, excessive growth is very undesirable. Water is a good thing, and in some cases a very necessary thing, but the use of it should be wisely regulated. At budding it is necessary that the sap should be free and the bark slip easily. To foster this condition it is sometimes desirable to give a watering a few days before budding commences. Water should be applied by running it through shallow furrows between the rows, and the cultivator should follow as soon as the ground is dry enough to work freely.

CHAPTER IX.

BUDDING AND GRAFTING.

IF the nursery ground has been well worked and the seed properly handled, the growth of the seedling will be strong and rapid. If an early start was had and other conditions favorable, some kinds will be ready for budding in June, and the production of what are called "June buds," as will be described presently. In ordinary practice, however, budding will come later, and the budding season extends from July to October. The weight of the budding is generally done in August and September.



BUDDING ILLUSTRATED.

The process of budding, as employed on all the common fruit trees, is very simple. It consists in lifting the bark and inserting a bud from another tree in such a way that the inner bark of the bud shall come in contact with the layer of growing wood in the stock, and then it will be quickly knit to it by the sap, if the bark is closed around the inserted bud closely enough to prevent the air from drying the two surfaces at the point of contact.

In the engraving *a* is the cutting or "bud stick" from the tree of the kind into which it is desired to transform the seedling. This cutting is to be made from the growth of the present season, which has well-formed buds at the axils of the leaves. If buds are desired to mature early, pinch off the ends of the shoots from which they are to be taken. Suckers and so-called "water sprouts" should not be used, but rather

well-formed wood from the branches of the tree. It is requisite that the buds be taken from a vigorous, healthy tree of the variety desired. Bud sticks can be carried or sent considerable distances if packed in damp moss or other material to prevent drying. Sealing the ends with grafting wax is also a good precaution against drying out.

Budding knives can be bought at all seed stores and cutlery establishments. They have a thin, round-ended blade at one end of the handle, and at the other end the bone is thinned down, or a bone blade inserted. The former is for cutting and the latter for lifting the bark of the stock into which the bud is to be placed. Armed with a bud stick and such a knife the "budder" starts in upon a row of seedlings. Bending the seedling over a little and holding it between his left arm and his left leg, he reaches down for a smooth place on the bark as near the ground as convenient to work, and makes a horizontal cut, and from that a perpendicular cut downwards toward the roots, as shown at *b* in the engraving, with the bark slightly lifted and ready for the insertion of the bud. Next he cuts from his bud stick a bud, as shown at *c*. This carries with it, on the back, a small portion of the wood of the bud stick as well as the bud and bark. It was once claimed that this wood should be carefully dug out, but in budding most kinds of trees it is not necessary; in fact, it may be better to leave it in; such at any rate is the general practice. The point of the bud is now inserted at the opening at the top of the slit in the bark of the stock and pushed down into place, as shown in figure *d*. To handle the bud the part of the leaf stem which is left on is of material assistance. Nothing remains now but to apply the ligature which is to hold down the bark around the bud.

There are various ways of tying in the bud. Any way will do which holds down the bark closely, but not too tightly. Different materials are also used, soft cotton twine, stocking yarn, strips of cotton cloth, candle wicking, etc. The last-named is perhaps the best material, on all accounts, although strips of cheap calico bear evenly upon the bark and do very good work. The use of twine is speedy, but the strands bearing upon a narrow surface, and not being elastic, they are apt to do injury by cutting into the bark unless carefully watched and loosened. The fiber from basswood bark was formerly largely used, but has given place to the other materials named, which are more handily obtained. The buds must be examined about a week or ten days after insertion, and the ligature loosened, for otherwise it will cut into the rapidly-growing stock. Sometimes trees are badly injured by neglect in this particular.

In making June buds, where immediate growth of the bud is desired, some growers make a hard knot with the cord around the stock, above the bud, and then use the loose ends to tie the bud. When the binding around the bud is loosened, the hard knot remains on the stock, girdles it, and forces the sap into the bud. Thin wire, known to nurserymen as "label wire," is also used for this purpose.

In going through the nursery row, all seedlings which are large enough are budded at once. In going through the row again to look to the bands, if the bud is seen to be fresh looking, it is considered to have "taken." In stocks where the first bud has dried up, another is inserted lower down. Sometimes seedlings which were too small to hold a bud at the first working over are given a bud later in the season, or left for taking up for root grafting in the winter.

In nursery practice the budder does not stop to tie his buds, but is followed in the row by another man who carries the tying material, and does this part of the work.

The common method of budding thus described is used on all common orchard fruits. Special styles of budding for special fruits will be described in the chapters treating of those fruits.

Usually the budded trees are allowed to stand in the nursery row with no other treatment that year than the insertion and care of the bud, the latter remaining dormant until the next spring. Then, as soon as the sap begins to swell the buds on the stock, the top is cut off down to about two inches above the bud, and all growth is kept off except that of the inserted bud. When that has grown out about twelve inches, the stub is cut off to about three-quarters of an inch or less from the bud, and the wood is quickly grown over by the bark. As there are apt to be dormant buds on the stock below the inserted bud, the trees have to be examined from time to time, and all such suckers removed. This is the common practice with budded trees. Exceptions will be noticed presently in connection with definitions of different kinds of trees known to the trade.

SPRING BUDDING.—What has been said in reference to budding applies to the use of dormant buds. It is also possible to work with what is called a "pushing bud." This process, as described by a distinguished French authority, consists of retarding the growth of the buds on the scions by burying them in the ground until the sap is starting well in the stock in the spring, and then putting them in, trimming off the top of the stock so as to force the bud into growth. In this way the growers of a rare variety may secure trees for planting out the following

winter, or he may secure a stock of buds for fall budding, and thus multiply his stock of a desirable variety very rapidly. A modification of this method is practiced to a certain extent in California, and may prove useful in some cases. It may be called budding with a growing bud. Mr. G. W. Thissell, of Solano County, takes buds in the spring when they have grown out even half an inch, and inserts them by the usual method of lifting the bark, when the sap is flowing well in the stock. He then cuts off about half the stock, so as not to give the bud too much sap at first, and afterward, when it is seen to have taken well, the balance of the stock is cut off near the bud. This method gives a tree the first season and saves a year over dormant budding.

GRAFTING.

The next process of propagation to be considered is that by grafting. Its success, as with budding, consists in bringing the growing wood (inner bark or alburnum) of the scion into contact with the same layer of the stock. It can be applied to any part of the tree, from the topmost branch to the lowest root, as is the case when new trees are made from scions and root fragments. Thus grafting pertains both to the production of young trees for planting out and to the transformation of old trees bearing worthless fruit into producers of choice varieties.

Grafting for the production of young trees is first in order. Instead of budding the seedling during the first summer of its growth, it may be allowed to complete its season's growth, and drop its leaves. When thus dormant the young trees are taken from the ground, the roots rinsed off with water if the ground is wet and sticky, or merely shaken free from clinging earth if in a dry time. Enough trees are dug at once to graft at a sitting. The grafting can be done at the work-bench in the tool-house or barn, and if one is pressed with other daylight work, it may be done by lamplight at the kitchen table, if the housewife can be conciliated for the muss it will make.

CARE OF SCIONS.—The scions should be previously selected, and whether taken from trees on the place or brought from near or distant sources away from the farm, should have been placed as soon as procured in moist earth on the north side of the house or other building, where they will keep cool and damp until one is ready to use them. At the East and in parts of this State where the ground is apt to freeze it is necessary to keep scions in the cellar with their butts covered with moist sand, but over most of the area of the State nothing more is needed than to put down in the earth at the base of a tree or on

the north side of a building, with, perhaps, a box or barrel inverted over them to keep out mice and other intruders. Care must be taken not to let them dry up. If it is desirable for any reason to keep scions dormant long into the spring or summer, of course storage in a cool cellar is better, for in the open ground the scions will burst into leaf after a warm spell of spring weather.

In selecting wood for scions, as for bud sticks, never take water shoots or suckers that start from the body of the tree and push up through the older branches, but always give the preference to sound, fully-matured wood, at the ends of the lower or nearly horizontal branches. Careful experiments have shown that trees grown from such scions are more likely to take on a low, spreading habit, than those from the central or upper branches. The scions should be tied in bundles with a stout cord, and a piece of a shingle, with the name of the variety written plainly and deeply, should be tied in with each bundle.

GRAFTING WAX.—In grafting, a good grafting wax is requisite. The ingredients are mixed in different proportions by different growers. A few recipes which are known to give good results are as follows:—

Two and one-fourth lbs. resin, 2 lbs. beeswax, ¾ of a lb. tallow.
One lb. mutton tallow, 2 lbs. beeswax, 4 lbs. resin.
Two lbs. resin, 2 lbs. beeswax, ¼ lb. tallow, and a little linseed oil.
Two lbs. resin, 1 lb. beeswax, 2½ lbs. linseed oil, 4 tablespoonfuls turpentine.

All these mixtures are made with the aid of gentle heat, and during grafting the wax must be kept warm enough to apply easily with a small brush. To do this the wax dish may be kept on a hot brick, to be changed for a fresh one as it cools, or, better still, is to heat the wax in an old fruit can or something of that kind, inside another, which is partly full of warm water. The wax should not be so hot as to run too easily, but just right to spread well.

Grafting is greatly facilitated by the use of strips of waxed cloth or waxed paper, the latter being quite good enough for root grafts, which we are at present especially considering. This waxed paper is made by spreading a thin coat of wax, with a brush, upon tough, thin wrapping paper, cutting up the paper, when cold, with a sharp knife on a board, into strips about an inch wide. Waxed cloth is made by dipping cheap cotton cloth into hot wax, pulling the pieces between the edges of two boards to take out as much wax as possible, and when the cloth is cold, tearing it up into half-inch strips for small grafts or wider strips

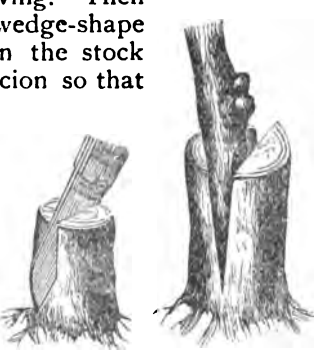
for large grafts. While grafting is going on in-doors, these strips hanging near the stove are kept in good, soft condition for use.

There are grafting preparations which do not require heating, but remain in a semi-fluid state, and then become very hard by contact with the air. The following is a popular French preparation:—

Melt one pound of resin over a gentle fire. Add to it one ounce of beef tallow, and stir it well. Take it from the fire, let it cool down a little, and then mix with it a tablespoonful of spirits of turpentine, and after that add about seven ounces of very strong alcohol. The alcohol cools it down so rapidly that it will be necessary to put it once more on the fire, stirring it constantly. Great care is necessary to avoid igniting the alcohol.

This wax is easily prepared, and when well corked will keep for six months. It is put on the wounded part of the tree, very thin, and soon becomes as hard as stone. Thus it is valuable not only for grafting, but for covering the scars caused by removing limbs in pruning. When bench grafting is done by nurserymen, of course all appliances are arranged for the speediest work, and wonderful results are attained by one man and a helper, even as many as three thousand root grafts of apple in ten hours. We are, however, merely discussing home practices.

CLEFT GRAFTING.—Where various-sized stocks are to be used, as will be the case with a bunch of home-grown seedlings, different styles of grafting must be used. Where the stock is much larger than the scion, as is apt to be the case with California seedlings, the cleft graft will be simplest. Cut off the top grown smoothly above the root crown and then split the top of the stock, as shown in the engraving. Then prepare the scion by whittling it to wedge-shape at the lower end. Open the slit in the stock with a little wedge and insert the scion so that its inner bark matches with the inner bark of the stock, something as shown in the second figure. It does not matter whether the outside of the scion is flush with the outside of the stock or not; the vital point is to get the growing layers just inside the barks in contact with each other, and, to be sure of this, it may be well to give the scion a slight diagonal pitch, for if the barks cross each other, this desirable contact is sure to be made. It is well to make the side of the wedge of the scion which goes



CLEFT GRAFT AT ROOT CROWN.

nearer to the center of the stock a little thinner than the outside.

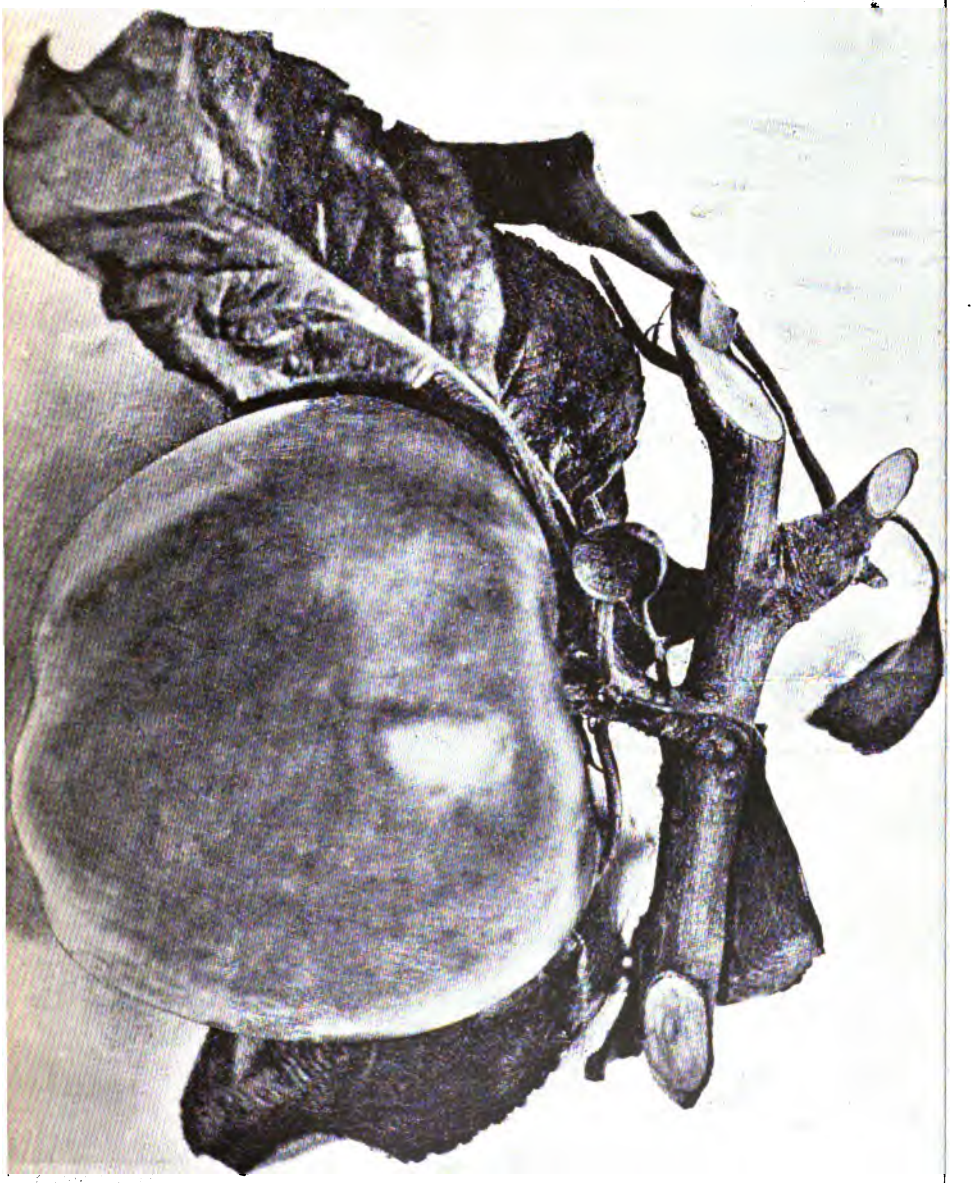
A scion for a root graft is cut longer than for use in the top of the tree, for in planting the point of grafting is placed a little way under-ground. Such scions are usually cut with four or five buds. After the scion is in place, it only remains to wrap it closely with a piece of the waxed cloth or paper, in such a way that all the cut surfaces are covered, extending the wrapper a little below the split in the root. Paint over the wrapper with warm wax put on with the brush, put a little on the top of the scion, and the graft is complete.

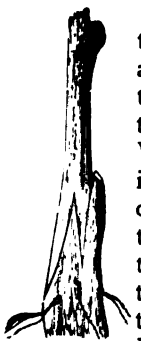
SIDE GRAFT.

SIDE GRAFTING.—Another method which prevents splitting the stock is the side graft shown in the accompanying figure. It consists in bending the stock to one side and cutting in diagonally with a thin-bladed, sharp knife, a little more than half way through the stock. Into this open cut insert the scion so that the inner barks touch, and allowing the stock to straighten up holds the scion firmly. Covering with a wax band drawn tight makes a good job, and such grafts make as good growth as the buds set the previous summer. This method can be used with stems or branches up to an inch in diameter, and is essentially the same as will be mentioned later as a side graft for working over old trees. In this style of grafting, a stub of three inches or more may be left above the graft, and to this the graft can be tied to prevent blowing out if it makes a strong growth. Afterward the stub is cut back with a sloping cut and waxed or painted with shellac to prevent checking.

WHIP GRAFT.

WHIP GRAFTING IN THE STEM.—Grafting above the root or in the stem of the stock when stock and scion are about the same size, is done by tongue or whip grafting. The accompanying sketch shows a whip graft in the stem of the stock. Grafts up to an inch in diameter can be made in this way, but it is generally used for smaller wood. Care must be taken to secure proper contacts of the inner barks at least on one side of the stock. After pushing the parts together, a wax band holds them firmly in place, or the joint may be simply tied and painted over with wax.

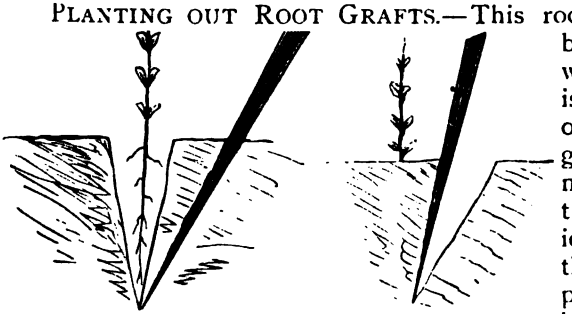




TONGUE GRAFT.

A ROOT GRAFT.—When the root stock and the scion are about the same size, the tongue graft is also used, as shown in the figure. In making this both the stock and scion are given a sloping cut of about the same length, and a secondary cut made in each. When the two are put together, the wood "tongues in," or interlocks, as shown in the engraving. The object of this is to make more points of contact for the inner barks of root and scion, and at the same time to interlock the two more firmly. In putting the two together, if the stock is slightly larger than the scion, be sure to put the scion so that the inner bark contact is made, and this will bring the scion a little to one side of the center. Bind with the wax band, and paint with wax as in the case of the former graft.

In large nursery practice expert grafters have come of late years to make this root graft without wax, merely tying in the graft. For amateur work at home it is much safer to use the wax.



PLANTING SEEDLINGS OR ROOT GRAFTS IN NURSERY ROW.

PLANTING OUT ROOT GRAFTS.—This root grafting can be done in the winter before it is time to plant out, and the grafts can be made a few at a time, as convenient. The grafts, then, as fast as prepared, should be bedded in moist sand in the cellar, and will make their contact firm, and even start to growing a little. In planting out in the nursery rows be sure the earth is firmed well around the root, otherwise many will be lost. The plant can be put in and the earth closed with a dibble, as seen in the sketch. Plant ten or twelve inches apart in the rows. Keep the weeds down and the soil well cultivated and loose on the surface, and the first season's growth will give a tree fit for planting out in orchard in the coming winter. For irrigation the same rules will apply as given for the growth of seedlings for budding.

PRUNING TREES IN NURSERY.

As for other treatment of the trees (either from bud or root graft) in nursery during the first year, there is some difference of

opinion and practice. If the young tree will be content to make a straight switch with good buds in the axils of the leaves, but no laterals thrown out, it will be in the best possible shape for planting in the orchard, and gives the planter a chance to make the head at whatever height suits him, and to secure uniformity through the orchard. All trees will not, however, be content with this growth, but will push out laterals all along the stem. Even in this case some let the whole growth go for the planter to treat as he thinks best. Another plan is to go over the nursery when the young stock is about two feet high and pinch back the laterals part way, but leaving on the leaves nearest the stem to shade it. This pinching back is done from the ground up to a height of one to one and a half feet, and above that the growth is left to take its natural course, to be cut as desired when the head of the tree is formed. Pinching back develops buds near the stem and gives the planter a better chance to head the tree lower if he likes. Another practice which prevails to some extent, and is strongly advocated by I. H. Thomas, of Tulare County, is to pinch off the terminal bud when the young tree has reached a height of about two and a half or three feet in the nursery. This soon forces a growth of lateral branches, which are in turn pinched after they have grown out a couple of feet. The result is the formation of a head on a nursery tree the first year, and when such trees are planted in orchard they are merely cut back on the laterals, leaving the head as formed in the nursery. Such trees are difficult to handle in packing, and take much room in shipment. There may, however, be an advantage in such practice for the home grower if he is situated in parts of the State where the greatest season's growth is attained. Orchard planters generally, however, prefer a dormant bud or a yearling of moderate growth, without laterals.

CLASSES OF NURSERY STOCKS.

The several classes of stock which are to be had from nurseries are as follows:—

ROOT GRAFTS.—These are seedling roots, or pieces of them on which scions of the desired variety have been grafted on the bench and the junction healed over in the cellar. No growth has yet started in the scion. If the tree planter wishes this kind of stock, he should plant it out in nursery row in the spring and remove the trees to orchard the following winter.

JUNE BUDS.—For the multiplying some desirable varieties very fast, buds are kept dormant in a cool place; or, by pinching

off the top, shoots of the current year are forced to mature buds very early. These buds are put into seedling stocks as early in the season as possible. After budding, the top of the stock is girdled with knife or cord, or partly cut away, and growth is forced on the bud so as to give a small tree at the end of the first summer. This method of propagation is growing in popularity in this State, especially in the foot-hill districts.

DORMANT BUDS.—Trees are sold in dormant bud when they are lifted from the nursery and sent out before any growth has started on the inserted bud. The bud should be seen to be the color of healthy bark.

YEARLING TREES.—These are trees which have made one season's growth from the bud or graft. Two-year-olds have made two seasons' growth, and so on. The proper way to count the life of a tree is from the starting of growth in the bud or graft, for this point is really the birth of the tree.

WORKING OVER OLD TREES.

Another operation which may be properly considered as a branch of propagation is the working over of old trees. There is much of this being done every year in this State. The old seedling fruits in the older settled parts of the State are being made to bear improved varieties; trees of varieties illy adapted to the prevailing conditions are changed into strong growing and productive sorts; trees are changed from one fruit to another, as with the tens of thousands of unproductive almonds which have been worked over into plums, prunes, and peaches. Still another reason for working over is to secure more valuable and marketable varieties. Sometimes a mixed orchard is made to bear a straight line of one sort which is in demand, or when the grower finds he has too many trees of a single kind, which give him more fruit than he can conveniently handle when it all ripens at one time, he works in other varieties so as to get a succession of varieties adapted to his purpose, and thus secures a longer working season in which to dispose of them. This is especially the case in large orchards of apricots, peaches, and plums, when the grower depends upon drying his crop. Information concerning the successive ripening of varieties can be gained from the special chapters on the different fruits. For all of these reasons, and others which need not be enumerated, the work of the propagator is continually going on even in our large bearing orchards. As with young trees, so with old, transforming the character of the tree is done both by budding and grafting.

BUDDING OLD TREES.—One way to prepare an old tree for budding is to cut back the branches severely during the winter, which has the effect of forcing out new shoots around the head of the tree, and in these the buds of the desired variety are set in the summer, just as is done in budding nursery stock, except that the budding should be done rather earlier because the sap does not run as late. When the shoots are budded, those being selected which are situated so as to give the best symmetry to the new head, the shoots not budded are broken a foot or so from where they emerge from the old wood, and are allowed to hang until pruning-time. At the winter pruning the budded branches are topped off a little above the bud and when the new shoot starts it is often loosely tied to the stub of the old branch to prevent breaking out in the wind. When it gets strength, the stub is cut away smoothly to allow the wound to heal over.

Another way is to insert the buds in the old bark at points where it is desirable to have the new branches start. This is sometimes done by lifting the bark, as in ordinary budding, and slipping the bud under, sometimes by what is called shield or plate budding, which consists in removing a piece of the old bark entirely and putting in its place a piece of bark of the desired variety, having upon it a dormant bud. With plate budding it is necessary to be careful to have the inserted bark just the size of the bared spot, and to wrap it more closely than when the bud is slipped under the bark of the stock. In all cases in budding old trees, care must be taken to get fully-matured buds, and it is well to take them from large shoots, which have a thicker and firmer bark than may be used in budding nursery stock. It is also desirable to be very sure that the buds are taken not only from a tree of the desired variety, but from a healthy, vigorous tree of that variety.

In selected buds, also, one must be sure that he gets leaf buds, and not fruit buds only. In taking buds from bearing trees, of course, he may sometimes, to get well-ripened buds, be obliged to take both fruit and leaf buds together. This will work well if care is taken not to rub off the leaf bud. It is rather easier, however, to work with buds from young trees not yet in bearing if one can be sure that these trees are of the desired variety.

GRAFTING OLD TREES.—Old trees are also renewed by grafting. This is most generally done by the old process of "top grafting," as practiced at the East. The main stem or the larger branches are cut square off, and the scions, usually two, but four or more if in the trunk, are shaped and set into clefts

in the stock as shown in the engraving. It is better to use limbs than to graft in the trunk, if the old trees are of good size. The following description, which the writer borrows in part from some unknown source, will serve to guide novices in the matter:—

CLEFT GRAFT IN OLD WOOD.

The outfit necessary for doing the work consists of a small, fine saw, a regular grafting knife, or a pocket knife with a long, straight, sharp blade, wax, light mallet, and a hard-wood narrow wedge. After selecting the limb to be grafted, saw it off—your own judgment will guide you as to best point, but before the saw gets quite through the limb, cut the bark on the under side of the limb to prevent the liability of peeling down.

Next split the stub with knife and mallet and insert the wedge in the center of the cleft to hold it open. It is usual to cut the scion with two buds, but sometimes better results are had by using scions with but a single bud. Whittle the scion wedge-shape, so that it fits nicely down into the cleft. To do this, hold it in the left hand with the bud at the ball of the thumb, then cut the side toward you; as will be natural, turn it over, and cut opposite side in the same way, making the wedge a very little thinner on the edge opposite the bud than the other. This will insure a firm pressure at the points where the bark of scion and stock meet.

When set the bud of the scion will be on line with the outer long portion of the graft. The point to be closely observed in adjustment is to have the inner or sap bark of the scion connect with the same of the stock. If a trifle too far in, or too far out, the work will be a failure. Some people set the graft a little out at the top and a little in at the bottom, so as to be sure of a connection at the crossing-point, but there will be firmer hold if there is a union the whole length. Our rule has been to have the wood of the scion come exactly even with the surface of the stock wood, and we seldom fail in getting firm adhesions and solid limbs, after years of growth.

After the scions are set, and two should be put into one limb if large, carefully withdraw the wedge and apply the wax, so that every part of the wood and bark cut and split is well coated. In doing this use extreme care not to move the scions at all from their sittings.

Most grafting over of old trees is done by this method, using one or another of the wax preparations described upon a preceding page. If the cut surface of the stock and the split is thoroughly waxed over as low as the bark is split, there is usually little trouble with the growth of the scion and the healing over of the stock. In the warmer valleys in the interior, the sun is often hot enough to melt the wax and cause it to run and bare the wood surfaces. This is prevented by dusting the wax thoroughly with brick-dust well powdered.

For grafting over trees by working upon the limbs, the neatest and surest work can be done by methods of grafting which do not require the splitting of the stock. There are various ways of doing this. One method is shown in the engraving on the next page, and consists in cutting the scion as shown, and inserting it beneath the raised bark and then binding well with waxed bands, the preparation of which has already been described.

Another method is an application of what the French call

oblique side grafting. It consists in making an oblique cut downward through the bark of the stock and for a distance into the wood, using a chisel and mallet or even a strong knife. This graft has already been shown earlier in this chapter. In it the scion is held in with a wax band. Some growers remove the top of the stock with a sloping cut about half an inch above the scion, as shown in the engraving, and wrap the waxed band well around and over all the exposed surfaces. Others do not remove the whole of the limb until the scion has started well into growth, and then they cut down and pare the stock and cover with a band or with a wax that will not run in the sun.

GRAFTING IN THE BARK.

Several ingenious devices have been patented by Californians for securing uniformity in the incision in the stock and in shaping the scion. Though there is promise in such devices, they have not yet come into general use so as to warrant description.

TIMES FOR GRAFTING IN CALIFORNIA.

There is nothing particularly new about the methods or means employed for grafting in California, but the time at which the operation can be successfully done, and the condition of the scion, are different from those held to be necessary in other climates. It is not at all requisite that the scions should be carefully stored away to keep them in a dormant condition, nor that the grafter should haste to do his work in just such a state of sap-flow in the spring-time. It was early discovered that grafting could be successfully done with growing scions, and that scions could be cut from one tree and set in another nearly at any time the grafter desired. The use of growing scions does especially well with the peach. If the top of the scion is waxed, the leaves do not even wither. The cherry has been successfully grafted with scions in bloom. Grafting is therefore possible much later in the season than is prescribed elsewhere, and it is also possible to begin earlier. In one of the largest apple and pear orchards in the State, in which perhaps more grafting has been done than in any other orchard, it is common to graft in December. The absence of freezing weather saves the graft from injury. As our trees start their flow of sap early, and often when the ground is too wet for comfortable orchard work, it is the practice of many to get their grafting and pruning done before the heavy mid-winter rains begin. The

practice of most growers is, however, to conform somewhat nearly to traditional methods, to do most of the grafting in the spring months, and to use dormant scions, the growth of which is retarded by heeling them in on the north side of a building, or keeping them in sand in the cellar, as the grower chooses. Of course it should be understood that there are parts of the State where the winter conditions are more nearly like those at the East, and practice has to conform to them.

As to whether it is better to remove the whole top of the tree and graft all the limbs in one year, there is some difference of opinion. The prevailing practice is to graft over part of the limbs one year and the balance the following year.

What has been said thus far relates especially to the working over of old trees of common deciduous fruits. Though much the same method will succeed with some of the semi-tropical fruits and with nut trees, the discussion of their propagation and grafting over will be deferred to the chapters devoted to them, and this will also give opportunity to describe methods especially adapted to these fruits.

CHAPTER X.

PREPARATION FOR PLANTING.

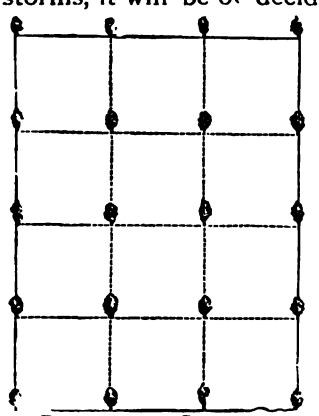
THE two essentials in preparing land for trees or vines are deep and thorough cultivation, and provision for drainage, unless the situation is naturally well drained. Drainage will be considered in a separate chapter, to which the reader is referred. In this place, however, by way of emphasis, it may be remarked that high land is not necessarily well drained, although the general feature of the surface may be an incline, nor is low land necessarily wet, although the surface may be apparently level. For horticultural purposes the drainage of the land must be considered on the hillside as well as in the valley, for reasons which will be more fully set forth in the chapter on drainage.

For the planting of orchard or vineyard the land must be put in as good tilth as possible, and extra expenditure to secure this will be amply repaid in the after-growth of the trees and vines. If practicable, it will be all the better to have the process of preparation begin a year before the plants are to be set. This is true either with newly cleared land, as has been described, or with old grain or pasture land which is to be used for fruit. Thorough and deep breaking up as soon as practicable to plow in the fall, and leaving the surface rough during the winter, facilitates the access of air to the lower layers of the soil, and in a certain sense may be said to sweeten and enliven it. Following in the furrow with a subsoil plow is very desirable, either at the first plowing or later. Such treatment of old grain land breaks up the old hardpan which has probably been formed by years of shallow culture. The preparation should continue during the following summer, and can often be made both thorough and profitable by the growth of a summer "hoed crop," the culture of which will kill out many weeds and secure good pulverization of the soil. If no summer crop is grown, the land should be kept in cultivation by plowing the weeds under as long as the surface soil retains moisture enough to start them. A special advantage of such summer-fallow in regions where the rainfall is apt to be short is that by prevention of evaporation the trees or vines set the following winter will have a good part of the rainfall of two seasons to grow with, and the result will often be very noticeable. If there are supplies of manure

available, as is often found in old corrals on our grain or stock farms, it is better to gather and apply this the winter before the planting of the trees. If this work is not done, then it should be left until after the trees are planted, and then be spread upon the surface during the winter, and plowed in in the spring after it has been in part leached into the soil by the rains. Application should be made evenly all over the surface and not massed around the roots of the trees, unless it is to be applied as a mulch to the surface after the spring cultivation is over, as will be considered later.

If it is thought desirable to plant the land immediately after breaking up, put in the plows as early in the fall as it is possible to do deep work, that is, to plow to a depth of ten or twelve inches, or more. Harrow thoroughly. If it is still early, cross-plow also deeply when the land pulverizes well, and follow in the furrow with the subsoil plow, working to a depth of fourteen inches or more. For this kind of work good teams are needed, and the plow should be sharp and bright. If the work is hard for the team, set the plow so as to take less land, but do not sacrifice the depth. Harrow again thoroughly, and the land is ready for the trees or vines.

AVOIDING DEAD FURROWS.—Unless dead furrows can be used to advantage for surface drainage in case of heavy rainstorms, it will be of decided convenience in laying off to have the field free from them. This can, of course, be secured by beginning the final plowing at a line in the center of the field, turning all furrows inwards. In this case, too, if a right-hand plow is used, the team will always turn on unplowed land, and thus avoid trampling upon and packing the loose soil. The slight ridge in the center of the field formed by the first two furrows can be easily leveled by a couple of back furrows, and when properly harrowed the field will be found smooth as a floor for staking out for planting.

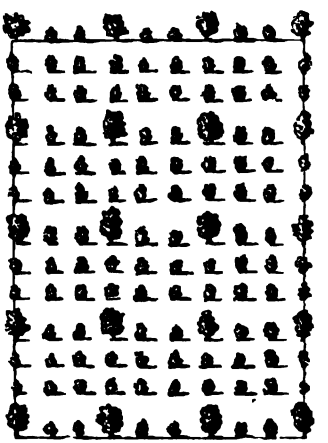


PLANTING IN SQUARES.

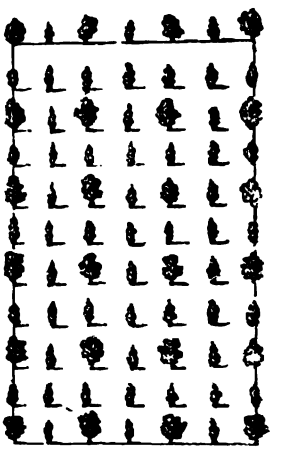
LAYING OUT FOR PLANTING IN SQUARES.

It is very desirable, both for convenience in cultivation and for the beauty of the orchard, that the trees should stand in straight lines, and care should be taken to attain that end.

Most orchards and vineyards in this State are laid out in squares; that is, the rows of trees or vines are all at right angles to each other, as shown in the accompanying sketch. This is the simplest arrangement, and by some of our largest planters is held to be the best. It is true that the trees are not equidistant from each other in all directions, and that, theoretically at least, there is a portion of the ground unused—supposing that the roots occupy a circle, as do the branches. Practically, however, it may be doubted whether the hungry roots of well-grown trees or vines leave any portion of the soil unvisited.



DOUBLE SQUARES.



ALTERNATING SQUARES.

There is also a form of double squares which is described by Mr. Lelong * as coming into favor among those setting out seedling orange trees as standards, with dwarf varieties between them. The same plan is available for planting figs, walnuts, or apples, at long distances, with early bearing trees between, which are ultimately to be cut out, or for vines between fruit trees.

Still another plan is the alternating of large and small trees, which is also desirable when the small growths are to serve their purpose and be removed.

VARIOUS WAYS OF MARKING FOR SQUARES.—There are various ways of marking off land in squares for trees or vines. If a man has a good eye, he can lay out lines almost faultlessly with very simple appliances, and these may be mentioned before considering more exact methods.

W. W. Smith, of Vacaville, marked off his large and famous

* Treatise on Citrus Culture in California, by B. M. Lelong, page 60.

orchard with a wheelbarrow. He fastens on the cross-piece back of the wheel an upright strip rising high enough to strike the level of the eye when the handles are in the hands. He begins by setting a stake in the center of the field, and two more in line on each side of the center. By starting at one side and keeping the eye at first on the line of four stakes, and afterwards on three, and so on, you can make a straight track with the wheelbarrow across the field. Then with a pole, in length equal to the desired width between the rows, you can reset the stakes for another line, and thus cover the field with parallel lines. Proceed again with the lines, at right angles to the first, and the intersections indicate the places for the trees.

The writer has seen Mr. Smith's orchard, and can testify to the regularity of the rows, but acknowledges that in attempting himself to apply Mr. Smith's method in his own planting, was obliged to abandon it, as he was unable to run the line straight.

LAYING OUT WITH THE PLOW.—Another way to mark off the orchard or vineyard in squares is with the plow. Mr. Mason, of Los Gatos, planted a twenty-acre orchard as follows: On the fence, at each end and side of the field, he nailed marks at the distance apart which he desired the rows of trees, and then starting with a plow drawn by a double team, from mark No. 1 at one end he went straight to mark No. 1 at the other. Returning, he drove one horse in the furrow already made, back again to the starting-point. Thus he had made a double furrow. This he repeated from end to end and from side to side, until the field presented the appearance of a checkerboard. Then, with the assistance of two men, he dug in each double furrow, at the crossings, a hole one foot deep, and at the bottom loosened the soil with a spading fork. He then planted the trees, and in this manner was enabled to set out the whole number, three thousand trees, in six weeks, and it is stated by one who visited the orchard that the trees stand in line with gratifying regularity. The objections to this method, however, would be, first, the displacing of all the soil in the furrows between the trees, which would require subsequent leveling; second, the danger of planting in furrows in some soils is considerable, because the water is apt to follow these extra deep furrows and settle about the roots of the young trees. In loose, well-drained soils, however, this objection does not hold.

An important modification of this method has been used recently in laying off some large orchards in the Sacramento Valley. It does not depend upon fence marks. A common two-horse turning plow is rigged with a "marker,"—a light

wooden bar extending at right angles from the beam, the bar being as long as the desired distance between the rows of trees. On the end of this bar a crosspiece is fastened perpendicularly, so that it scratches along on the surface of the ground. The line of the first furrow has to be designated by a flag stake, to which the plowman proceeds. When this is done, the team is turned and sent back along the next row, the location of which has been fixed by the marker, and so on for the length of the field, the marker being turned each time to indicate the next furrow. Following the same course the other way of the field leaves the trees to be planted at the intersection of the furrows.

MARKING OFF WITH SHOVELS.—Another way to proceed from marks on the fences or from stakes at the sides of the field, is as follows: Place these marks or stakes all around the field, at the distances desired for the rows. Let two men take two ropes long enough to reach from side to side, the men at opposite sides on the field. They fasten the ends of these ropes at marks one and two, drawing them tight, so that they stretch across the field parallel to each other, and represent the position of the first and second rows of trees. Let the two men take shovels and walk towards each other, marking along in the soil with the shovel the course of the rope until they meet in the center of the field. Then the men go to the next rope, and, beginning in the center, mark towards the ends. Then they move the two ropes to the next two marks at the sides and proceed as before. By continuing this work until the marks are all drawn one way across the field, and then doing the same from the marks on the other two sides, the field is laid off in squares and the trees or vines are to be set at the intersections of the lines.

MEASURE AND SIGHT.—Another method which is quite commonly used and answers a good purpose in small plantings is the combination of measure and sight. The sighting stakes are usually plasterers' laths pointed at one end and whitewashed to make them more visible to the eye. In the use of these it is necessary to measure the distances and locate the laths to mark the ends of the rows all around the field. Then locate a line of laths across the field each way through the center, these laths occupying places which the trees of these two central rows will fill. After these are in place, measurement can be dispensed with, and the job can be finished by sighting through. The man on the ends of the rows has three laths to sight by in each row, and the stake driver places the stakes as directed by the sighter. Good location can be done this way if a man has a good eye and patience enough.

MARKING OFF WITH A WIRE.—A measuring wire or chain is, perhaps, the best means for getting accurate location of trees or vines. It is used either for setting in squares or in other arrangement, as will be described presently. Measuring wires are made of annealed steel wire about one-eighth of an inch in diameter. The length varies according to the wishes of the user. If it is desired to lay off the plantation in blocks of one acre, the wire should be two hundred and eight feet nine inches long, for that is approximately the length of one side of a square inclosing an acre of ground. But some use a wire as long as three hundred feet, when the acre measure is of no consequence; and others, in smaller plantings, make the wire just the length of the piece they have in hand. At each end of the wire is fixed a strong iron ring about one and one-half inches in diameter, to be slipped over stakes; some use a larger ring, say three inches in diameter, because it is easier to handle in pulling taut. Along this wire, patches of solder are placed exactly at the distances desired between the rows of trees or vines, and to these places pieces of red cloth are sometimes fastened so that the points may be easily seen. Another style of measuring wires is made of a small wire cable about a quarter of an inch in diameter, made of several strands of small wire. It is more flexible and less likely to become kinked than the large wire, and can be easily measured and marked off to represent the distances at which rows of different kinds of trees should be placed. This is done by separating the strands a little at the desired points and inserting a little piece of red cloth, pressing the wires together again and tying firmly with a waxed thread to prevent slipping. In this way the same wire can be easily arranged for planting vines or for the trees requiring the greatest distance between the rows. Another advantage of the cable is that any stretching can be taken up by retwisting, which cannot be done with the stretching of a single wire.

FINDING A TRUE CORNER.—To use the measuring wire for laying out trees on the square, it is necessary first to get one corner true, and then a field of any size can be marked out accurately. Select the side of the field which is to serve as the base of the square and stretch the wire along that, say fifteen feet from the fence, which will give room enough to turn with the team in cultivation or to drive along in picking-time. When the wire is thus stretched parallel with the boundary of the field, place a stake at each of the distance tags on the wire, and these stakes will represent the first row of trees or vines. To find a square corner, begin at the starting-point and measure off sixty

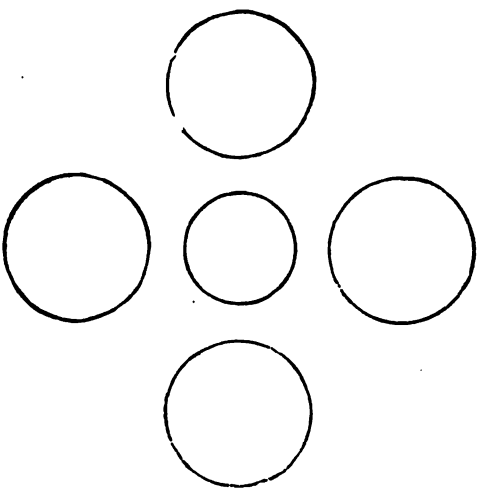
feet along this row with a tape-line, and put a temporary stake, then from the starting-point measure off eighty feet as nearly at a right angle with the first line as can be judged with the eye, and run diagonally from this point to the temporary sixty-foot stake. If the distance between these stakes is one hundred feet, then the corner is a right angle. Now having the outside lines started at right angles to each other, one can proceed with the measuring wire and lay off as large an area as he desires, if care is taken to have each line drawn parallel with the last, and all stakes accurately placed with the tags on the wire—providing the land is nearly level or on a uniform grade. In locating trees over uneven ground, the measurements will have to be made from tree to tree, with the tape-line held as nearly to a level as possible.

ROWS ON HILLSIDES.—Laying off orchard or vineyard on steep hillside is generally done in the same way as on level land, as nearly as possible, but there is advantage sometimes in departing from these rules. Mr. G. W. Thissell, of Pleasant Valley, Solano County, has had much experience in hillside fruit growing, and he advises that, on land too steep to plow both ways, and where constantly all plowing and cultivating has to be done one way, the rows up and down the hill be placed nearly twice as far apart as the rows along the face of the hill. In planting trees thus the advantage to be gained is by enabling you to keep the team well up the hill; thereby you are able to plow or cultivate the trees close on the lower side of the rows. There is no difficulty in cultivating the upper side of the rows, for the plow or harrow is always below the team. If trees are planted as recommended, the team can be guided up the hill a little between the rows, then allowed to drop down hill one step, and thus one can cultivate the trees close on the lower side. The same rule will apply to vines.

QUINCUNX PLANTING.

There is much confusion in the use of this term in this State. It is, in fact, made to cover almost every kind of arrangement which is not on the square. Webster defines the term to mean "the arrangement of things, especially of trees, by fives in a square, one being placed in the middle of a square." The proper use of the quincunx is for the location of some temporary growth which will serve its purpose and be finally removed, leaving the permanent growths in squares. Thus this form of planting has but limited use in this State. Trees set in quincunx would stand as shown in the accompanying diagram. To locate them in this form it is only necessary to proceed as already

described for planting in squares, by fixing upon the base line and locating two side lines to it at right angles. Place the stakes on these two lines just half the distance desired between the trees, and have the measuring wire long enough to reach across from one line to the other. Near one end of the wire place another mark just half way between the end and the first tree mark; that is, if the trees are to be twenty-four feet apart in the squares, this additional mark should be twelve feet from the end of the wire. Now set the first row with the end of the wire at the corner stake and set stakes at each twenty-four-foot mark.



QUINCUNX.

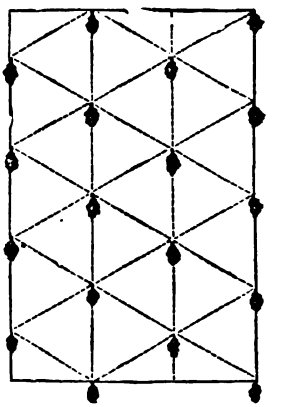
Proceed now to the first half-way stake, and instead of putting the end of the wire at this stake, put the twelve-foot mark there. Put stakes now at each twenty-four-foot mark again to locate the trees in that row. In the next row put the *end* of the wire at the first stake and proceed as in the first row. Thereafter using the end of the wire and the twelve-foot marks alternately, the stakes will be set in quincunx all over the field. If the mid-way stakes are now pulled out along the two side lines, the remaining stakes show where the trees are to be placed. This way of planting locates about seventy-eight per cent more trees upon any given area, but it brings the trees at irregular distances from each other, and except in furnishing a way to arrange an orchard with permanent and temporary trees, there does not seem to be any advantage in it.

PLANTING IN EQUILATERAL TRIANGLES.

This is the arrangement generally implied when the term "quincunx" is wrongly employed. By it the trees are all equally distant from each other, and thus the ground as equally divided as possible. The arrangement admits fifteen per cent more trees to the acre than the setting in squares, and the ground can be worked in three different directions. This arrangement also

gives better facilities for irrigation. Objections are urged to it, however, in that it does not admit of thinning trees by removal of alternate rows, as is sometimes desirable, and that one has to take a zigzag course in driving through the orchard.

Hexagonal planting places the trees as shown in the accompanying sketch.



TREES PLANTED IN HEXAGONS.

It is termed hexagonal because, as the figure consists of six trees inclosing a seventh, a line drawn through the encompassing trees makes a hexagon. It is also called septuple planting, because seven trees enter into its figure.

There are various ways of laying off ground to place trees in this arrangement. Working from the diagram given herewith, set stakes at A, B, C, D and E, in a straight line, and the distance apart you wish the trees to stand. Then fasten a tape line at C, so that it will turn on the stake, and from B describe a circle to F, G, D, H, I, and to the starting-point, B. Now with the line divide the circle, starting at B or D, into six equal spaces, and set stakes at F, G, H, and I. You now have six trees surrounding a seventh, any three of which standing the nearest together are exactly equidistant, and more completely fill the space than any other arrangement can.

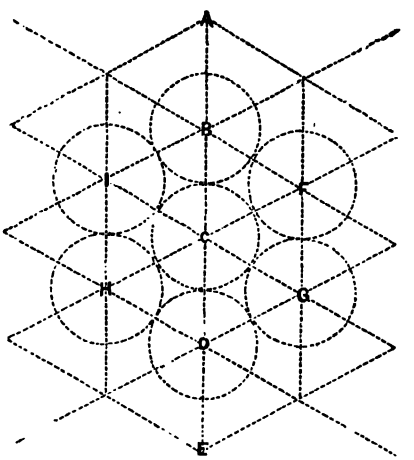


DIAGRAM FOR HEXAGONAL PLANTING.

An orchard can be laid out in hexagonals by using the measuring wire as described for quincunx planting with the distance and half-distance marks, except that the guide stakes in the side rows must be placed at different distances apart. Mr. H. A. Brainard, of San Jose, gives* the following useful table, showing the distance for side stakes to reach desired distance between

Santa Clara Valley, Nov., 1887, p. 137.

the trees, and the method of calculating the numbers of trees to the acre by the square and hexagonal or septuple arrangement:—

Trees set Septuple.	Check-stakes should be
10 feet apart	8 ft. 8 in.
12 " "	10 " 4 2-5 "
14 " "	12 " 7/8 "
16 " "	13 " 10½ "
18 " "	15 " 7 "
20 " "	17 " 4 "
21 " "	18 " 2¼ "
22 " "	19 " 7/8 "
24 " "	20 " 9½ "

After the field is staked, each alternate stake in the check rows should be removed. The following table will show the number of trees to the acre by the square and septuple system:—

	Square.	Septuple.
10 feet apart	435	500
12 " "	302	347
14 " "	222	255
16 " "	170	195
18 " "	134	154
20 " "	109	125
21 " "	99	114
22 " "	90	103
24 " "	75	86

For any distances not given in the above table, calculate the number of trees to the acre by the square system, and add fifteen per cent. This will give the number if planted septuple.

LAYING OFF A TEN-ACRE ORCHARD IN HEXAGONALS.

Mr. P. W. Butler, of Penryn, Placer County, gives* the following explicit directions for laying off a ten-acre orchard in hexagonals, with proper driveways around the outside and through the center of the tract:—

Take a steel wire, two hundred and thirteen feet long and about one-quarter of an inch in diameter, composed of several strands. Three feet from one end open the strands, and draw through the opening a piece of flannel one-half an inch wide and one inch long; wrap the flannel around the wire and close the opening, then tie the flannel firmly with a waxed end. Place twenty-four of these marks on the wire at the exact distance of nine feet from each other, alternating with white and red, and the last mark will be three feet from the end. Attach each end of the line to a hard-wood stake two feet long, and it is ready for use.

Take a second wire one hundred and ninety-three feet long, and beginning three feet from the end, attach thirteen marks at equal distances of fifteen feet and seven inches, and fasten the ends to stakes as above. The length of this line between the extreme marks will be one hundred and eighty-seven feet, and the length of the first line will be two hundred and seven feet. When trees are planted eighteen feet apart, in equilateral triangles, the rows will be fifteen thousand five hundred and eighty-eight feet distant from each other. This can be ascertained if the trees are set at any distance apart, by obtaining the square of the distance, and from it subtract the square of one-half the distance, and the square root of the remainder will be the distance between rows.

To lay out and mark for planting a square field of ten acres proceed as follows: Take eight redwood fence posts seven feet long that are free from knots. Saw them

**Pacific Rural Press*, 1885.

into five pieces of equal lengths and split them into stakes of about three-quarters inch square, and they will make about one thousand four hundred stakes (the number desired), and these are to be set in the exact position in which the trees are to be planted.

Two parallel avenues should run through the field dividing it into three plots of equal size. This can be done by leaving out one row of trees to form the avenue.

Sufficient distance should be left between the trees and fence to allow a team to pass along without coming in contact with the trees when full grown. Fruit can then be collected and placed on conveyances either on the avenues or along the line of the fence, without carrying by hand a distance of more than one hundred feet from center of plots.

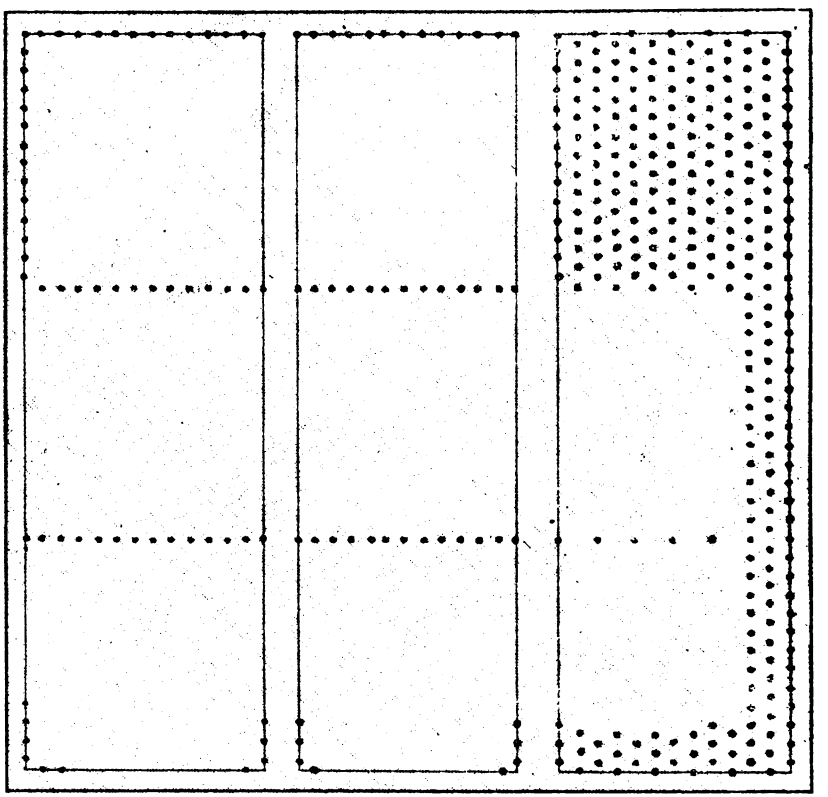


DIAGRAM FOR LAYING OUT TEN ACRES IN EQUILATERAL TRIANGLES.

Attach a white flag to a pole of sufficient length to be seen from the opposite side of the field, and in a corner put it into the ground at a point nineteen and one-half feet from the fence that runs at right angles with the avenues, and eighteen and one-fourth feet from the fence that runs parallel to the avenues; then cross the ends of the proposed avenues to the opposite corner. Place a similar pole at the same distance of nineteen and one-half feet from the one fence and eighteen and one-fourth feet from the other; and at the other side of the inclosure place a pole at each corner at the same distances from the fence, being careful that they are firmly set in the

ground and in an exactly perpendicular position. Stretch the fifteen-foot-seven-inch line in the direction to cross the avenues; place the mark nearest the end against the pole, and drive the stake attached to the line into the ground; have the man at the other end draw the line taut and place a pole with a flag attached in the ground at the mark nearest his hand that will be in a direct line with the pole on the opposite corner; then drive the stake to which the line is fastened, and each person pass along the line and set stakes at every mark, being careful that the line is always kept straight, and the stakes all set on the same side of the line. Continue in the same direction, and from the last pole place another at two marks, as a base. This marks the avenue.

Place the line with another pole at the end, as before, and stake; proceed with the line, and at two marks from the last pole place another, and the distance between this and the one at the corner should be just one hundred and eighty-seven feet, or the length of the line, but should there be a variation, the corner pole should be changed to the exact point reached by the last mark on the line, and that must be the permanent corner. Now, with the same line proceed to the opposite side of the field, and run a parallel line, and place the poles and stakes in the same manner as before described, moving the corner pole, if necessary, and meet the mark at the end of the line. The fifteen-foot-seven-inch line is always used in a direction that crosses the avenues, and the nine-foot line only in a direction parallel to the avenue. Now, take the other line and proceed to cross the field at right angles to the last. Place a pole at the end of the line, and at intervals of eighteen feet set stakes, and the last stake, which will make thirty-five in the line, should be nine feet from the pole in the corner; but if it is not just that distance, move the pole to that point, and then the first row of stakes set must be changed, and make a straight line between the corner poles.

Run a parallel line on the opposite side of the field in the same manner, placing a pole at the end of the line at each length and stake between, when the field will be inclosed by stakes that are in exact position. Now, with the same line place stakes on each side of the avenues, at intervals of eighteen feet, beginning with each row on the same side of the field, and the last stake in each row will not reach the opposite pole by nine feet. With the fifteen-foot-seven-inch line now set stakes between the poles across the avenues. There will be two lines of these central stakes, and these set you have no further use for the fifteen-foot-seven-inch line. The field can now be staked to completion with the nine-foot line. Place the line in position, and if the first row of stakes were set by the red marks, place the next ones by the white marks, alternating in this manner throughout the work. By drawing the line taut, and giving it a swing, it can readily be moved to the next stakes. The utmost care should be taken to see that the line is always kept straight and not moved while the stakes are being set, and that all stakes are set on the same side of the line.

In lining over a hill the mark at one end will not quite reach the pole or stake, and the difference in distance must be equally adjusted between all the stakes along the line.

By carefully following the above directions there will not be a variation of an inch in the stakes from a direct line in looking across the field on a row in any direction, even if hilly, and the equilateral triangles will be perfect. After the staking is finished, pass along the four cross-lines, and remove every alternate stake, which will be found to be only nine feet from the others in the row. The diagram on the preceding page will assist in making these directions plain to the reader

LAYING OUT HEXAGONALS WITH A TRIANGLE.

It is possible to lay out an orchard in hexagonal form by working from stake to stake with an equilateral triangle of dimensions equaling the distance required between the trees. The following method is described by Professor W. C. Damon, of Napa:*

**Pacific Rural Press*, Feb. 2, 1884.

Take three strips of one-by-two-inch dry pine or redwood, and as long as you want—say twenty-four feet for apples or pears, or twenty feet for cherries or plums. Cut the strips the same length, and fasten the corners of the triangle firmly together by nailing to pieces of pine board six by six inches.

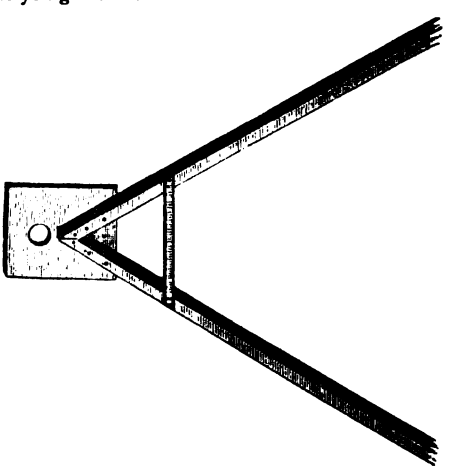
If the long strips are set up edgewise, the triangle will be much stiffer and better to carry. Through the corner boards bore an inch hole, making sure that the three sides of the triangle measure exactly the same. If they do, the triangle must necessarily be perfect. Then brace it a little by nailing a lath across each corner, and it is ready for use.

Now split out some three quarter-inch pins, one foot long, from a good, straight-grained redwood post. Make one hundred pins for each acre you have to lay off. Do not use lath for pins, as they will cost double and will not be half as good.

Three persons must now carry the triangle, beginning on one side of the field, say eight feet from the fence, and guided the first time through by a line of stakes. Carry the triangle with its side to the line of guide stakes and its point in. The head man and the inside man will stick pins, while the rear man will slip his corner each time upon the pin set by the head man.

After the first time across, the man at the inside point of the triangle alone will set pins, while the other two fit their corners upon the pins in the last row set. Thus one row of pins only is set each time you go across the field.

If the triangle is exact, and the first row of pins is set perfectly straight, and the pins are always set perpendicularly, everything will now work like a charm and the job will be perfect; and it is so simple and easy that a man and two small boys can lay off from five to ten acres in one day. Remember that no guide stakes are used anywhere after the first time through.



ONE CORNER OF TRIANGLE—ALL BEING MADE ALIKE.

THE TRIANGLE ON HILLSIDE.—The use of the triangle has been found quite satisfactory on level land. Mr. Geo. A. Raymond, of Alma, reports that it requires a little nicety in "leveling up" where the piece is hilly. He writes:—

I had three slopes, one to the west, one to the south, and the other one to the east. By using a plumb-line at two corners of the triangle, the third corner resting on one of the stakes, leveling the triangle and bringing one of the plumb-lines over another stake already set, the position of the other line would determine the position of the stake I wished to set. This method worked fairly well, and I do not see but that the trees line as well as could be expected on uneven ground. In some places the slope was sufficient to give a fall of six feet between the trees, which were set twenty feet apart.

LOCATING IN TRIANGLES WITH A CHAIN.—Instead of using a wooden triangle, Mr. W. R. Spaulding, of Los Angeles County, advises* the use of a chain in this way:—

**Riverside Press*, March, 1883.

I first stretch a chain along one side of my orchard ground, setting by it the first row of stakes. This, I may say, forms the base line. I am provided with a piece of chain just twice the length of the established distance between trees, with ample rings on the ends and a joint in the middle. I tell my boy to put one of the rings over the first stake and the other over the second stake. Then I take hold of the joint in the middle of the chain and stretch it out reasonably tight. My wire forms a letter V, at the focus of which I stand and proceed to stick a stake. The point is indicated with precision by the joint in the middle of the chain. The two ends being fixed and the chain stretched, the apex of my equilateral triangle falls in only the one place, and that is the place I want to find. My point determined, I tell the boy to take the ring off the first stake and put it over the third stake, leaving the one on the second stake where it is. Then I tighten my chain again, and another point is fixed. Thus I continue all the base line, making the boy shift the rings alternately, turning over the chain as one turns a pair of draughtsman's compasses in his hand when spacing off a line. The second row of stakes being set, I set the third row, and so on through the ground. I have followed this method in staking my orchard land this year, and I find it simple, accurate, and quick. It only requires fixing one line to begin with, and after that the trees come just right if care is taken not to allow the chain to tangle its links.

The suggestions given in this chapter should indicate ways enough to lay off orchard and vineyard ground to answer all needs, though there are other good ways not mentioned. It is hoped that the instructions will not be regarded as too explicit. They are intended for the guidance of the inexperienced planter, and will naturally seem laden with detail to those who have become familiar with the operations by repeated practice.

CHAPTER XI.

PLANTING THE TREES.

AFTER the field has been thoroughly tilled and carefully laid off as has been described, the next step is digging the holes for the trees. "How large shall the holes be?" He was a wise fruit grower who, when asked this question, replied, "As large as the field." That is to say, it is much better to work the whole ground over deeply than to trust to deep holes and shallow working elsewhere. Where this is done, the tree holes need only be large enough and deep enough to receive the roots without folding them in or cramping them up. In a loose, deep soil, however, one can dig extra deep and broad holes if he desires, and will be repaid by extra growth of the tree; but in a close, tenacious soil a deep hole is not only undesirable, but often positively a danger to the tree, unless drainage of the holes is provided artificially. Such holes hold water like a tub, and the loosening of the soil deeply facilitates its gathering in the hole. Many have found their trees in such places dwindling and dying because their roots were soaking in water.

PLANTING ON SOME SHALLOW SOILS.—As a rule, trees should have a deep soil, and for these deep, free loams, California is famous, but there are situations where very satisfactory growth and production can be had, even when the hardpan is near the surface and the soil would be called shallow. In such places it is the character of the subsoil which warrants the tree and vine planter in making use of them. The best illustration of such situations is the large area of what is called "bed-rock land," adjacent to the city of Sacramento, which has already been discussed in the chapter on soils. It is about twenty years since Mr. James Rutter, of Florin, began planting trees and vines on this soil, and he has lived to laugh at those who laughed at him for choosing such a place for his orchard and vineyard. He early noticed that there were vines here and there which grew exceptionally well and bore large crops of fine fruit. He found by investigation that under these vines there were crevices in the bed rock, and from this he took the hint to bore through this hardpan in the bottom of the hole where he placed the tree, and in this way he gained access for the roots to the subsoil and

egress for the water through the permeable substratum. He bores a hole two inches in diameter into or through the bed rock and rams well into it one and a half pounds of black blasting powder. After exploding this, he sometimes bores a three-inch hole about four feet below the blast. Instead of blasting in the hole where the tree is to be planted, some bore and blast the hardpan midway between the rows, placing the holes at "quincunx" with the trees. The shattering of the hardpan between the trees is said to be practicable after the trees are growing, and may in certain soils relieve trees which are suffering for lack of drainage.

Concerning the blasting of hardpan soils Professor Hilgard says:—

> The kind of explosive to be used with the greatest advantage will naturally vary from place to place, with the nature of the hardpan, and will have to be ascertained by trial, which could best be made before the rains set in. But in view of the fact that the substratum of the "bed-rock lands" is shown to be actually richer in plant food than the surface soil; that while in its natural condition it not only obstructs the passage of the roots mechanically, but also injures them by the formation of poisonous solutions in consequence of the stagnation of water, all of which can be relieved by the shattering of the substratum by means of judicious blasting, also giving the roots access to abundant moisture; it would certainly seem that in favorable locations, where land is valuable, this mode of rendering it available for fruit culture deserves most earnest consideration. Neither the adobe nor the "bed rock" should be used in the filling up of holes after planting, any more than a raw subsoil should be turned on the surface in other cases. But with the access of air and water to the shattered portion, the substrata will gradually go through the processes of soil formation; and their plant food will doubtless become available fast enough to insure the welfare and productiveness of an orchard for the usual period.*

There are situations here and there over the State where such practice would be beneficial, and in some cases mere digging or boring through the impervious stratum avails much. On the bench back from the Mokelumne there are spots where "lava crusts" overlie gravel, and trees have been well grown by cutting holes through the lava to the gravel, filling with good soil and planting the trees in these holes. Their roots penetrate to the gravel stratum and obtain abundant moisture and nutriment. This "lava" is quite soft when not exposed to the air, but being quarried hardens so as to serve as building stone.

In certain situations where a shallow layer of soil overlies a heavy clay, trees have been blown over, but when a cut has been made through the clay, the trees have rooted deeply and have withstood the winds.

The benefits of holes for drainage have been clearly shown by years of observation at Marysville, where in planting shade trees it is customary to bore down about fifteen feet, until a stratum of gravel is reached. These matters do not, of course, enter largely into the calculations of the California fruit-tree

* Rep. Agl. Ex. Stations, 1890, p. 63.

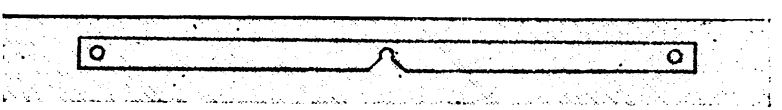
planter, but they are of occasional application and may help some to understand peculiar behavior of their trees.

DIGGING THE HOLES.—Holes for tree planting may be dug at a leisure time after the laying off of the field, even though it is not designed to plant the trees immediately, but our largest planters do not approve the practice. In such cases the sides of the holes should always be freshly pared off before the trees are put in, because the rain and sunshine are apt to cement the sides. In digging holes the surface earth should always be thrown on one side and the lower soil on another. The object of this is to have the top soil to place in direct contact with the roots when the tree is planted, the lower soil being used to fill up the hole with.

An interesting apparatus for digging holes by horse-power has recently been introduced by Truman, Hooker & Co., of San Francisco. It consists of an earth auger mounted on a truck and the horse works the auger both down and up by means of a sweep. The auger cuts a hole two feet in diameter, but any desirable size can be furnished, and the hole is cut three feet deep or less as desired. It is well spoken of by those who have used it. It is called the "Lightning Tree Planter."

TREE SETTERS.

No matter how carefully the stakes are placed in laying off the orchard, the trees will not easily come in line unless some handy device is used for bringing the stem just in the place occupied by the stake which was thrown out in digging. These

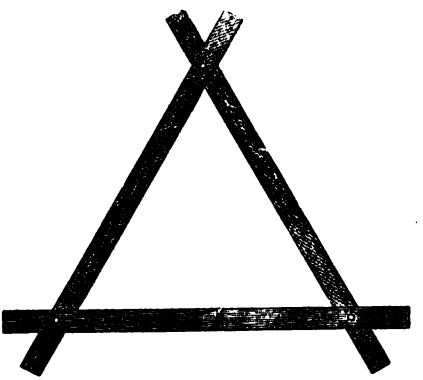


BAR FOR TREE SETTING.

devices are called "tree setters," and there are a number of designs. Two are given, either of which will give good results. Take a piece of board one inch thick, four inches wide, and five feet long; bore an inch hole in the center, and one at each end at equal distance from the center; then cut a piece from one side of the board, marked by a square, the corner resting in the middle of the center hole. Make two stakes, each one foot long, that will easily pass through the end holes. Place the center of this board against the stake; where the tree is to be planted, push the stakes into the ground through the holes in the ends, then lift the board from position and proceed to dig the hole. When dug, replace the board over the end stakes in its former

position, then plant the tree with its trunk resting against the center notch in the board, and you have it in just the right place.*

Another setter is in the form of a triangle: Take three pieces of plain one-inch stuff three to four inches wide and four feet long, and nail them together, forming a three-cornered frame, letting the ends project sufficient to form a corner, as shown in the drawing. Next make a couple of smooth, hard stakes, well sharpened, and about a foot or sixteen inches in length. When you are ready to set your trees, place the frame flat upon the ground with one corner firmly and fairly against the stake which marks the place where the tree is to stand. Now in the other two corners stick the stakes already prepared for the purpose. This done pull up the stake against which the frame was first placed—the one indicating a place for a tree—remove the frame, being careful in doing so not to move the other two stakes, which must be left to be used while setting the tree. After the hole is dug and everything ready for setting the tree, again place the frame against the two standing stakes, let the tree drop into the other corner, which will help support it while the dirt is being placed about the roots; and this will bring the tree exactly where the stake was originally. If the stakes are properly put in line, so will be the trees.†



TRIANGULAR TREE SETTER.

These setters are described as they are used when the hole is dug and the tree set at the same time. Such is the ordinary practice in planting. If one wishes to dig the holes beforehand, it is necessary to furnish more stakes, as two have to be left beside each hole to mark the position of the setter when the planting is done. Besides its use in bringing a tree into line, the tree setter enables one to judge of the depth of setting as compared with the surface of the surrounding ground. It is not easy to determine this with the eye if the hole be a large one. Where the measuring wire is used to set the stakes, it is sometimes stretched across again after the holes are dug, the tags on the wire thus indicating the places for the trees of the whole row.

* P. W. Butler, of Penryn.
† W. P. Mundy, Petrolia.

The trouble with this practice is the bother of having the wire in the way while filling and tramping the earth around the roots.

SELECTING TREES.

In the purchase of trees it is well to patronize nurserymen in your own district, providing they are honest and intelligent men, who keep themselves informed as they should about their business. The advice of such a local nurseryman is often of great value to the new-comer, for he will know by his experience and observation much about the adaptations of fruits and varieties thereof to the region. If, for any reason, local nurseries do not meet your needs, seek some well-established nursery at a distance. It is much safer to deal directly with the grower of the trees than to patronize traveling agents. Where, however, these agents are the accredited representatives of well-known establishments, they may save the planter time and trouble by taking his order for him. So-called "tree peddlers," who are jobbers in trees and in too many cases send you refuse trees which they pick up cheap wherever they can, and label them to suit, without respect to truth or honesty, should be resolutely avoided, no matter what inducements or blandishments they may offer.

It is desirable, if possible, to visit the nursery yourself, and see the stock which is to be furnished you. The trees should have a good, healthy look, with clean, bright bark and of size enough to indicate a good, free growth. The matter of size is not the only point to consider, for size of the top is not so desirable as well-matured wood and plenty of roots. On the other hand, stunted trees are not, as a rule, worth planting, for a stunted tree is like a stunted calf, does not make a good after-growth. There are cases, however, in which, by extra cultivation in good soil, fine trees have been grown from "culls" from the nursery. The best rule is to select trees of good medium size, straight and healthy. In judging size, however, one must take California and not Eastern standards, because our nursery stock, if well grown, invariably is of much greater size than Eastern. Ask to see samples of the roots as well as the tops and do not purchase trees unless the roots are healthy looking and free from knots or excrescences. Gnarly and knotty roots in the young tree are a sure sign of insect pests or of unhealthy growth, and planting such trees has occasioned our orchardists immense loss. Many have been led into purchasing poor trees because they may be had cheap. A tree selected merely because it is cheap may prove the most expensive thing a man can put in the ground.

GUARDING AGAINST INSECTS.—The top of the tree should be carefully examined to discover scale insects if there be any. For this purpose a hand-magnifier should be used. Such a glass should always be in the fruit grower's pocket. One can be bought at any optician's for a dollar or two, which will fold into its case so as to be carried without scratching. Our nurserymen, by forsaking old infested locations and obtaining new ground, now sell much cleaner trees than they did a few years ago, but still it is well to be always on the watch for pests. If there is any doubt, it is best to have the trees dipped root and top. This is done by having a tight box or vat large enough to completely submerge a tree or bundle of trees, as may be desired. The following mixture may be used:—

Make a soap solution of one-quarter of a pound of the best whale-oil soap to each gallon of water, and for every twenty-five gallons of this solution add one pound of American concentrated lye or its equivalent; four-fifths of a pound of "Greenbank caustic soda, ninety-eight per cent." The mixture should be used warm, one hundred and ten degrees Fahr., and the tree should be left in the solution at least fifteen seconds.

TAKING TREES FROM THE NURSERY.

Trees should be carefully taken from the nursery rows so as to obtain a good amount of small branching roots. In lifting from the home nursery, digging with well-sharpened spades, which will sever the long roots cleanly, is perhaps the best method. In the large nurseries the newly-invented tree diggers are generally used. They have two revolving coulters, which cut through the surface soil each side of the trees, and a sharp, curved blade, which is drawn through the ground under the trees, loosening the soil and severing the long roots cleanly. The tree is then easily lifted, and has generally a much better root system than by the old style of "ploughing out," which broke off so many of the fibrous roots and lacerated the larger ones. Whether the taproot should be retained or not is not worth discussing on theoretical grounds. As a matter of fact and practice, the taproot cuts no figure at all in California orchard planting to-day, although the discussion of the question was very warm in this State thirty years ago. It is important, however, that the planter should have as many small lateral roots as he can get.

The roots, after lifting, should not be permitted to dry. Hence, in hauling from the nursery to the farm, the trees should be well covered with wet straw and old sacks, or, if shipped from the nursery to distant points, should be well packed. The best way to pack trees is, undoubtedly, to box them in with wet straw,

but it costs less and they usually carry well moderate distances if carefully bundled with tules, the roots packed in wet straw, and, especially about the roots, the packing and covering bound down tight with ropes to prevent drying out.

Attention should be paid to hauling away trees from the railway stations as soon as possible after arrival. It is not uncommon for shipments to lie on the station platforms for days, often when a desiccating north wind is blowing. Such treatment soon takes the life out of the rootlets, and often, no doubt, the nurseryman is blamed for failure of trees which have suffered some such neglect as this, either from transportation companies or from the purchasers.

HEELING IN.—On arrival at the farms, trees should be "heeled in" as soon as possible; even if it is the intention to plant at once, heel them in just the same, for delays arise often in the most unexpected manner. To heel in, dig a trench or plow a deep furrow, or a double furrow, in light, moist, but well-drained soil; put in the trees singly side by side, removing all the packing material carefully from the roots, laying the tops all one way, and then shovel the earth over the roots until they are well covered with loose soil, and be sure that the soil sifts down well between the roots. Ordinarily this treatment will hold the trees in good condition for a considerable time if need be. If, however, they have become dry before arrival, the bundles should be thoroughly drenched with water before heeling in. In extreme cases, where the top shows drying by shrinking and shriveling of the bark, the trees should be drenched, and then they should be covered root and top with earth for two or three days, when, if the trouble has not gone too far, the bark will recover its smoothness and plumpness. It should be very seldom, however, that a lot of trees is allowed to get into such condition by neglect. In heeling in it will be found a great convenience and a safeguard against possible confusion by loss of labels, if each variety as taken from the packing is placed by itself in the trench. Nurserymen generally attach a label to each small bundle, if the trees are of several varieties, and the novice is apt to lose all track of his sorts when heeling in the trench, unless he heels in each kind by itself, leaving the nurseryman's label to mark the whole lot of each kind.

If the planter has his own ideas of after treatment of his trees, or if he is a beginner and desires to adopt the suggestions which will be laid down in this book, he should insist that the nurseryman shall not trim up nor cut back the trees before packing. Have the trees packed just as they are lifted from the

ground. The work toward the shaping of the tree should be done after it is planted in orchard.

PLANTING THE ORCHARD.

The best time for planting out deciduous fruit trees in most parts of California is immediately after the first winter rain which is sufficiently heavy to moisten the soil to a considerable depth. The young tree should be dormant before being moved, and if its leaves have fallen it is good evidence of its dormancy. Such, however, is the effect of the climate of California, more apparent in some years than others, and with some kinds of fruit than others, that the young tree retains a small part of its activity very late, and in such cases it is not practicable to wait for the complete falling of the leaves. Sometimes, for convenience of work, the trees have to be lifted before this takes place, and in such case it is desirable to remove the leaves to lessen evaporation. It is probably better to transplant in this condition for the sake of early setting in its new position than to wait for all the leaves to drop. This statement is not intended to include nursery stock which is kept growing late in the season by late irrigation. Such trees are not desirable.

TIME TO PLANT.—Early planting of common orchard fruits is of advantage for several reasons. First, an early-planted tree gets the full benefit of the season's rainfall whatever it may be, and a late planted tree, in a year with short rainfall, is apt to suffer during its first season's growth, unless it can be irrigated. The two main things to observe are the dormancy of the tree and the proper condition of the soil, and both of these are most apt to coincide in most parts of California about the first of January. There will, however, be some variation from year to year, and different parts of the State disagree as to date. Hence, the general rule must be based on conditions, that of the tree and that of the soil. If the novice cannot judge these for himself, he must get the advice of someone of experience in the locality.

The dormant period of a tree in California, as has been stated in another connection, is very short. As many cold-climate annual plants become perennial here, so our deciduous trees, in comparatively frostless portions of the State, evince a tendency to become evergreen. The period of dormancy in the root is also shorter than the inactivity of the top. Trees transplanted early are found to have their root wounds calloused over and new rootlets considerably advanced before the buds swell. Therefore, by early planting the tree begins soon to take hold

upon the soil, the latter being well settled around them by rains, which often follow early planting, and the high winds, which are apt to come in the spring in some parts of the State, find the tree well anchored and ready to maintain itself.

Again, the proper condition of soil, if not seized at its first coming, may not recur until after the great storms of the winter are over, say in February or March (in most parts of the State), and then often the buds are bursting into bloom and leaf. Planting when the soil is water-soaked and cold is very undesirable, for in such condition it cannot be properly disposed about the roots, and trees moved at this period are apt to show their dislike of the treatment. If the work has been delayed unavoidably, so that early planting cannot be done, it is better to keep the trees heeled in until the proper soil condition returns, even if it be rather late, for a little extra attention to cultivation for retention of moisture will pull through a late planted tree.

These remarks are of very wide application in this State, but there are exceptions. In our high altitudes where the climate approaches Eastern conditions in cold and snowfall, practice in planting will also approximate Eastern methods. In regions of very heavy rainfall and on the upper coast where the rainy season and moisture from fogs are prolonged late in the spring, late planting is safer and surer than in the warmer, drier parts of the State.

Another consideration, too, is the slope of the land to be planted. Our hillside fruit growers in regions of heavy winter storms sometimes plant slopes, which, if plowed deep in the fall, are apt to wash badly during the heavy winter rains. On such slopes it is better to plow late in the winter, after the heavy storms are over, and plant when the soil has become warm and mellow.

THE OPERATION OF PLANTING.

Tree planting should be carefully and well done, but it need not necessarily be slowly done. With a kind soil deeply worked and just in the right condition for planting, trees may be put in well and rapidly. Two men work together at a decided advantage. Using the straight "tree setter," which has already been described, one takes each end, and as soon as the center notch incloses the tree stake, the setter stakes are pushed into the soil, the "setter" is laid aside, and the two men, taking up their shovels or spades, begin first around the outside of the hole, throwing all the surface dirt on the same side of the hole and leaving the tree stake to be thrown out last because its remaining serves to center the hole. The lower soil is now thrown to

the other side of the hole, and when depth enough is reached, the soil at the bottom of the hole is loosened up to the depth of a shovel-thrust, without removing it from the hole. A shovelful or two of the surface soil is thrown into the center of the hole, being allowed to remain higher in the center, because this generally furnishes a cushion about the natural shape of the under surface of the root system of the tree. Now replace the tree setter upon its end pegs, let one man hold the tree with its stem in the central notch in the setter, and while the other man shovels in the surface earth rather slowly at first, the man who holds the tree with one hand will spread out the roots, pulverize and pack the earth around them, being sure that no cavities are left under any of the roots, but that their surfaces everywhere come in contact with the soil, and that they spread out as widely as possible. The earth is being continuously put in by the shoveler, and when the roots are covered the planter steps in the hole and carefully firms the soil down upon the roots by tramping (especially at the cut ends of the roots around the outer side of the hole), at the same time judging of the perpendicularity of the tree with his eye. When this is done, both men use their shovels and fill up the hole with the earth taken from below, being sure to leave the last few inches at the surface pulverized, but untramped, unless the soil be very light so that tramping will not overpack it. Someone said long ago that one should not plant a tree as he does a post, ramming down the earth to the very top of the hole. Many trees are doubtless ruined by overzeal in this respect.

The shovel has been mentioned frequently as the tool to be used in planting. Where the soil is deeply plowed, well worked, and free from stone, the shovel is the most rapid tool. Under other conditions the long-handled spade, and in some cases the long-handled spading-fork, serves admirably in loosening the soil at the bottom of the holes and in breaking up lumps while filling in. One man with a shovel or spade, and the other with the fork, makes a good combination in some soils.

RANDOM SUGGESTIONS.

There are a few points not mentioned in this running account of planting:—

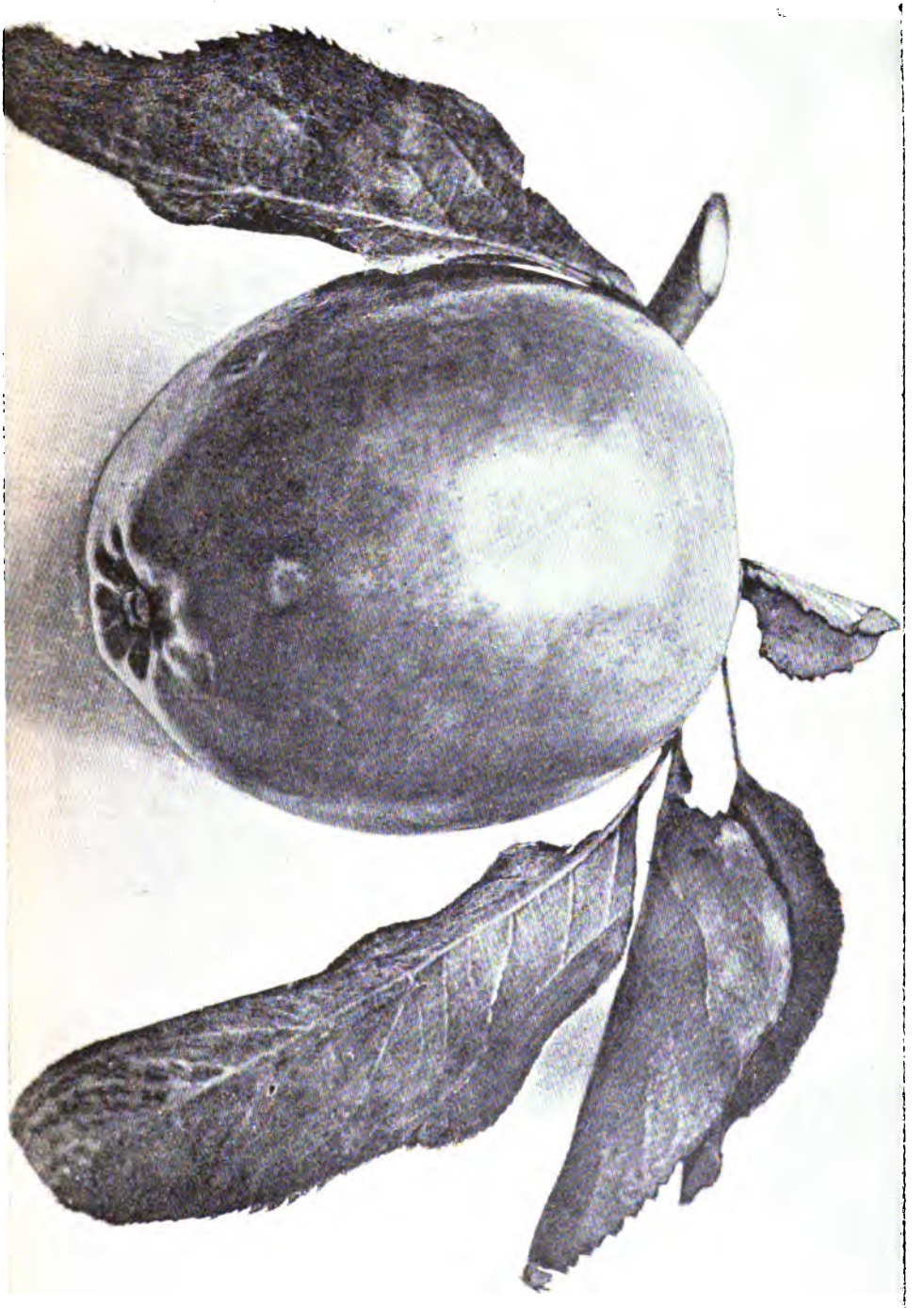
The roots of every tree should be examined before planting. All large root ends should have a fresh, clean cut with a sharp knife or shears. Make a slanting cut with the cut surface on the under side of the root. Where a root is mangled or bruised, it should in most cases be cut back to a sound place.

The tree should be placed if possible with the same side toward the sun as was exposed to the sun in the nursery; at all events, the wound made by the cutting away of the seedling stock above the bud should be at the north or northeast, in order that this weak point may be shaded as much as possible from the afternoon sun.

If the roots of the young tree grow more to one side than the other, place the strongest roots toward the prevailing wind.

The use of water to settle the earth around the roots is sometimes desirable in sections where the rainfall is light or uncertain. Pour in the water after the hand work in spreading the roots and in pressing the soil under and around them has been done and the hole partly filled. When the water has soaked away, fill the hole with fine earth *without* tramping. In early planting in parts of the State where the rainfall is abundant, there is no need of the troublesome process of water settling; in late planting, however, it will sometimes be found of advantage. Puddling the roots, or dipping them in a thin mud and planting with this mud adhering, is governed by much the same conditions as water settling; it may insure the growth of the tree when otherwise it might be seriously injured by drought. With puddled roots especial care should also be taken to leave the surface loose to prevent evaporation. In making puddle, use loamy soil and never adobe, for in dry time the latter will bake around the roots and often kill the tree.

THE USE OF MANURE.—Never put manure in the hole with the tree. Sometimes the injunction is, Never put anything but well-rotted manure in the hole. It is better to put none of any kind. Manure should be spread upon the ground after planting. The rains then leach it out and it may be turned under in the spring plowing. There are, however, light soils in the drier parts of the State where turning under manure in the spring is a disadvantage, as it makes the soil too porous and facilitates evaporation. On such soils, extra care should be taken to have the manure thoroughly decomposed by composting, as will be described in the chapter on fertilizers, and all applications should be made either late in the spring to act as a mulch during the summer, or if a mulch is not thought desirable, apply the manure in the fall before the first rains, so that it may be turned under at the first plowing and have the whole winter for disintegration. In this dry climate there is often misapprehension, especially among new-comers, as to what is well-rotted manure. They take the scrapings of the corral, which have been trampled and pulverized, but which, having been kept dry, have never



rotted. When this is put in the holes with the tree and then moistened by rainfall or irrigation, it will burn the tree, the first sign of the injury being the drying up of the leaves. It is, on the whole, safest and best to put nothing but well-pulverized surface soil around the roots of the young tree.

DEPTH OF PLANTING.—The depth to which trees should be set has always been a matter of discord among planters. The safest rule is to get the tree as nearly as possible the same depth it stood in the nursery row; that is, so as to have it stand that way when the ground has settled. Of course in planting in a furrow, which is not a very desirable proceeding, though sometimes done, one has to note whether he is planting where the next plowing will throw the earth toward or away from the tree, and set his trees so as to conform with the normal level. In planting in loose soil in the drier parts of the State, it may sometimes be desirable to plant rather low. But if irrigation is to be practiced, it must be remembered that the water level will rise when the soil is saturated, and deep-planted trees are apt to suffer. The experience of recent years is decidedly against deep planting, which used to be advised because of our dry climate. Thousands of trees have been ruined by planting too deep.

SPEED IN PLANTING.—On good soil, well prepared, trees can be put in rapidly and the job still be well done. It is reported that J. D. Smith, of Livermore, planted sixty-four acres of almonds for A. T. Hatch, in March, 1887, using twenty men and finishing the sixty-four acres from Friday noon to Wednesday night, placing the stakes, digging the holes, and planting the trees. This would be almost three-quarters of an acre per day per man. Mr. Hatch, in planting peaches and apricots on his home place in Suisun Valley, has averaged one hundred trees per day to the man. On the mellow loam at Lodi, San Joaquin County, the average was one hundred and twenty-five trees to the man, digging holes two feet square in land which had been plowed twelve inches deep. Such work is only possible on good soil, well prepared, and by men who work well together.

MAPPING AND LABELING.—Where mixed varieties of fruit are planted, the orchard should be mapped as soon as the trees are set. A good, durable map is made of the glazed muslin, such as carpenters and architects use for their drawings. The map can easily be drawn to a scale by using a fraction of an inch to represent a foot. After the map is made, it can be rolled on a broom stick or a curtain stick and is easily preserved.

With such a record, the grower need not care what becomes of the labels, as he can locate a variety any time by its row and tree number. If, however, one desires labels, let them be made in this way: Take a piece of common sheet zinc five inches wide. Across this cut pieces three-quarters of an inch wide at one end and tapering to a point at the other. Near the wider end write plainly with a common lead pencil the name of the variety. This will get brighter by exposure to the weather. The small end may be coiled around the branch of the tree; it will yield as the tree grows and will do no injury. Such labels will last for a long time. Labels attached by cord or wire should be removed as soon as the trees are set, for they are apt to be forgotten and the tree seriously injured by the cutting in of the ligature. Even when labels are used the map is the only surety, because any kind of a label is apt to be lost by accident or by malice or mischief of intruders.

MULCHING.—Although early-planted trees on deep soils in regions of sufficient rainfall need only good cultivation after planting, there are cases in which mulching is desirable. Various light materials may be used for a mulch, but nothing is better than well-rotted straw, in which fermentation has killed all weed seed. Apply it to a distance of two feet around the tree, and to a depth of not less than six inches. It is best done as soon as the tree is planted, and is to be especially recommended when late planting is practiced. In localities where little rain falls, if the trees are well mulched early in the winter, irrigation may be unnecessary. Trees planted very late in the spring may, by using great care and mulching well, make as great a growth as those set out in early winter. This should not be an excuse for late planting, but we mention it to show that where late planting is *necessary*, mulching will help the trees to pull through. It is a far easier way of keeping the ground moist than by irrigating. Of course this does not mean that a mulch will obviate irrigation where systematic irrigation is found necessary, though there are indications that irrigation may often be lessened, and in some cases obviated, by extra cultivation or mulching, at least until the trees come into bearing.

GUARDING AGAINST SUNBURN.—Newly-set trees should be protected against sunburn. There is nothing easier and neater than to push a "shake"* into the ground so that its shadow will shade the stem of the tree from the afternoon sun. If set on the southwest side, it will do this. Where shakes are

*Shakes are pieces of wood three feet long, six inches wide, and one-quarter of an inch thick, split or sawed from California redwood.

not at hand or are too expensive, the stem of the tree may be bundled with straw or wrapped with paper. Manufactured "tree protectors" of paper which are readily adjusted around the trees are now largely sold. Such protectors when made of blackened paper have been found to invite sunburn instead of prevent it. This objection does not hold to the use of light-colored paper. Millions of trees have perished in this State, and as many more condemned to sickly lives, because of sunburn, and borers which seek the injured bark for entrance. Pruning has much to do with saving trees from this evil, as will be shown in the proper connection, but in the hotter parts of the State the first precaution should be to shade the bark of the young tree with some artificial protection.

CUTTING BACK AT PLANTING.—Whatever idea the grower may have as to shaping his tree, it must be cut back when planted. Lifting from the nursery has removed a considerable part of the root system of the young tree and the top must be reduced accordingly. The planter who dislikes to sacrifice the fine top will sacrifice future growth and vigor by retaining it. The tree may struggle through and regain strength, but it will for years be smaller than if it had been properly cut back at planting. If the moisture supply should be short, a tree may die the first summer which would have survived if differently treated at planting. The manner of cutting back depends somewhat upon the style of pruning to be followed afterward, as will be considered in the next chapter.

CHAPTER XII.

PRUNING ORCHARD TREES.

IT is not intended to enter into a discussion of the general theories of pruning. The reader desiring to pursue them is referred to the abundant literature on the subject in Eastern and European treatises. The effort to approve or condemn these theories by considering them in the light of California experience and observation might lead to interesting conclusions, but it has no place in a work aiming merely at an exposition of what appears to be the most satisfactory practice in California fruit growing. It will be found that this practice varies somewhat in the different regions of California, sometimes in degree, sometimes in kind, because of different local conditions, and it might be found that nearly all reasonable theories of pruning could be verified in California experience.

It may be remarked, however, that pruning in California is at present almost exclusively intended as a *shaping* process. Our fruit trees are naturally so prone to bear fruit that pruning to produce fruitfulness is seldom thought of, and still more rarely practiced, while pruning to reduce bearing wood, and thus decrease the burden of the tree, is quite widely done, to take the place, in part, of thinning out the fruit. Pruning to restore vigor to the tree, as in cutting back to make a new head, is also rather a rare proceeding, probably because our trees are generally too young to require it. It may be said, then, that at the present stage of California fruit growing, we prune for shape and for the many practical advantages which inhere in the form now prevailing in California orchards of deciduous fruits. Some of these advantages are peculiar to our climate; others we share with those who advocate a similar form elsewhere.

Though it may not be possible, perhaps, to substantiate any claim to originality in California methods of pruning, it is quite certain that some practices are prevalent here to an extent which, perhaps, their distant originators never dreamed possible; and so well do the practices suit the conditions, that our best orchards of the same fruits in adjacent localities are almost identical in form and general appearance of the trees, and those

more distant differ chiefly in the extent to which the same principles are applied. And this is not because the trees are allowed to follow their natural inclination, which should secure resemblance, but because their natural bent is resolutely conquered by agreement of growers that they know what is good for the tree; and this substantial unanimity is the result of the experience of the last thirty-five years. Those who advocate preserving the natural habit of the tree in pruning, would be shocked to realize that in California we often study the habit of the tree that we may more successfully repress or change it. Probably there is no part of the world where trees are grown as "natural standards" in so unnatural a manner as in California.

FORM OF TREE BEST SUITED TO CALIFORNIA CONDITIONS.

Deciduous fruit trees should be grown in California as "low standards." They might be described by Mr. Barry's term "dwarf standards," which he defines as "similar to standards except that the trunks are low, not over two or three feet in height, and the head is retained in a smaller space."* But the term "dwarf standards" is so closely connected with the idea of a dwarfing stock—although it is true that this is not always implied—that it is undesirable. California had thousands of dwarf trees in early years, but now we grow trees on free stocks almost exclusively, as has already been stated.

The form of tree which prevails with singular uniformity all over the State is the "vase," or "goblet," or "wine-glass" form, all these terms signifying a similar general shape. There are different ways in which this form is secured and maintained in different parts of the State, and with different fruits, which will be especially noted in the chapters devoted to these fruits The very elaborate forms of training which are practiced in Europe, and to some extent in the Eastern States, and which are so faithfully described in the standard works on fruit growing, are not to be found at all in California, and will have no place in this work. Some of them are not suited to our climate, and others, which are devised for the protection of the tree, are not necessary here. It is possible that when the State becomes more thickly settled, and land is more difficult to obtain, we shall see "fruit gardens" again in California, as there were thirty years ago, but now if one wants fruit at all on a small area he grows a few standard trees, or secures more land and grows an "orchard."

*"Barry's Fruit Garden," p. 223.

ADVANTAGES OF LOW HEADING.—The mainspring of success in California is to grow low trees. Low is a term admitting of degrees, it is true, and may imply a trunk of six inches up to one or two feet, in the clear. There are old trees with much higher stems, and in some parts of the State they are safe, but few experienced fruit planters now head their trees high.

Low heading has for us all the advantages for which this practice is approved in other parts of the world, viz., accessibility of fruit and ease of pruning, symmetry and solidity, and consequent decrease of danger from high winds, greater facility of approach to the trunk with the horse in cultivation. This last point has been contested and fought out on our own soil, for experience has demonstrated that properly-trained trees with low heads and obliquely-rising branches are handier for the cultivator than high-headed trees with drooping horizontal branches. But these general advantages of low-trained trees are not the chief ones secured in California by low heading. Hundreds of thousands of trees have been destroyed by the exposure of a long, bare trunk to the rays of the afternoon sun. The sun-burned sides have given the conditions desired by borers, and destruction has quickly followed. Sometimes young trees have not survived their first season in the orchard, because of burned bark; or this, with the added injury by the borers. It is also found by California experience that growth is more vigorous in the branches when they emerge near the ground. Even where actual burning may not occur, the travel of the sap through the longer distance of trunk is undesirable. It is believed, also, that benefit results from shading of the ground at the base of the trees, by reducing evaporation, and by maintaining a temperature of soil better suited to vigorous root growth.

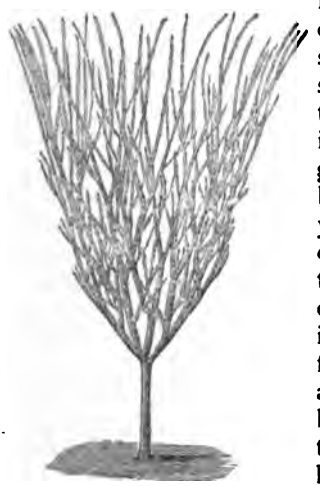
LOW HEADING INFLUENCED BY LOCATION.—But whatever may be the reasons, the fact is indisputable, the higher the prevailing summer temperature, and the greater the aridity, the lower should the trees be headed. Trees which will do well in the central and upper coast region and adjacent to the Bay of San Francisco, with twenty-four to thirty-six inches of clear trunk would dwindle and probably perish in the heated valleys in all parts of the State. In such situations, both north and south, the best practice is to head the tree fifteen, twelve, and some even hold as low as six inches from the ground. There will always be some difference in opinion as to detail, but the necessity of making the trunk short enough to be effectually shaded by the foliage is admitted by all growers. Thus it ap-

pears that we are making extremes meet in our tree training, and are growing standards almost as bushes. Of course in so doing there has to be attention given to feathering down the branches well with leaves or pinched-off shoots, or securing spread of the top, so that the main branches do not become exposed and invite the fate from which it is designed to rescue the trunk.

WHENCE CAME OUR PREVAILING FORM OF TREE?

As the vase form of tree has become so prevalent in California, and shows such adaptation to our conditions, it may be worth while to refer briefly to its origin and development. It is a product of French ingenuity in the training of dwarf trees, and has undergone considerable modification in California, losing much of the accuracy of its form and gaining vastly in speed of work, without sacrificing any practical value which inheres in the design.

Mr. Barry reproduces the substance of a method of securing the vase form with the peach as laid down by M. Louis Gaudry, of Paris, in a small work written by him, and from the same source, also, the engraving given herewith.* M. Gaudry starts his tree by heading back to two feet or higher, then allowing three buds to start at the top, rubbing off all which start below. The branches from these three buds he draws outward, fastening them by cords driven in the ground, all side shoots on these branches being pinched off. The next year these branches are released and cut back to six or eight inches from the base, to a leaf bud on the outside of the branch which has a bud below it either on the right or left side. The front bud continues the main branch, and the side bud makes a secondary branch. All other shoots save these two are pinched off at three or four leaves. Hoops are now placed in the interior, to which the branches are bound to keep them in place. The next year the process is repeated, save that the secondary branch is brought out on the side opposite to that of the secondary



FRENCH STYLE OF VASE (BARRY).

*"Barry's Fruit Garden," edition of 1853, p. 234. In later editions this engraving is used differently, and, as far as I can judge from the description, incorrectly.

branch of the previous year. The fruit is grown upon shoots which grow on both sides of the primary and secondary branches. All shoots which start to grow either inward toward the center or outward are pinched back, so that the tree really becomes vase-shaped, with a comparatively thin wall of growth, the center quite open and the exterior with a true outline. This process, of course, will produce a very symmetrical form. Instead of having a central trunk or leader, it has a series of leaders and secondary branches regularly disposed around the circumference of the vase, as the engraving shows.

A modification of the foregoing is the "wine-glass" form, which was described by Captain Wm. K. Austin, Dorchester, Mass., in Hovey's *Magazine of Horticulture*, in February, 1865.* He used the method which he describes for training dwarf pear trees. He started with a two-year-old tree, headed it back, taking out the central stem, and usually obtained a small growth the first season. This is cut back, and from the vigorous growth of the second season the form of the tree is outlined. He took ten or twelve leaders, the lowest eighteen inches from the ground, and a clear stem below that. Nothing but these leaders are allowed to grow, all side shoots and spray being kept down by nipping off with light shears, leaving always a few leaves at the base of the twig. These leaders grow fast and are topped in midsummer to check and concentrate the energies of the tree and stock it up. This process is repeated each year, and all pruning is on small shoots and no large limbs to remove. Captain Austin did not use any artificial appliances for locating his branches, but allowed them to spread after their natural habit. Captain Austin's plan does away with the central trunk or leader and substitutes about a dozen side leaders arranged as nearly as may be around the circumference of his wine glass, as the accompanying engraving shows.

AUSTIN'S WINE GLASS (BARRY).

The vase form is mentioned by many French writers. It is, says Du Breuil, to be preferred in situations liable to high winds.

* "Barry's Fruit Garden," edition 1872, p. 259.

He states that it may be secured by taking up five branches vertically, or they may be made to cross each other alternately left and right, following an angle of 30.° M. Du Breuil prefers this method. The leaders are advanced spirally and held in place by lashing to hoops. This does not, of course, have as great resemblance to our California style as the growth with vertical leaders as described by M. Gaudry, as has already been cited, or as described by Robert Thompson in his report on the fruit and kitchen gardens near Paris, to the journal of the Horticultural Society of London, for 1847. Writing of the gardens of the Luxembourg, he says:—

> All the quarters containing fruit trees are surrounded with borders planted with cherry, plum, and apricot trees as standards, and some, with excellent effect, are trained as dwarfs in form of a vase or goblet. . . . The head is formed hollow, in shape like a goblet, the shoots being annually tied to hoops of wood adapted to the circumference required to give the desired form. Two hoops are sufficient, the two-year-old arm being tied to one and the equidistant regulation of the one-year-old shoots is effected upon the other. As the vase or goblet widens, of course hoops of greater circuit must be prepared. . . . Shoots are apt to spring up in the center of the goblet, but they must be pinched in summer. The form is very ornamental, it can be produced at little expense, and the trees were well furnished with fruit buds.

Mr. Barry, in his "Fruit Garden," describes the common method for training "dwarf standards" in vase form. He starts with a low head and three or four branches. The first year all superfluous productions are rubbed off, and a balance maintained among the shoots by pinching. The second year the shoots of the previous season are shortened about one-half, as a general thing, the cut being made at a good, plump bud capable of producing a vigorous shoot, and this is selected to prolong the branch. If one or two secondary branches are needed to fill the space, those next the leader, if properly situated, are chosen, and all below them are pinched when about two or three inches long, to check the growth of wood where it is not needed, and to convert them into fruit branches or spurs. The third year the shoots of the previous year are cut back as before, say to four, five, or six eyes, according to their strength. One shoot is chosen to continue the prolongation of the branch, and the others are pinched in season to convert them into fruit spurs. Thus the tree is conducted from year to year until it has attained the full size required.

HOW THESE FORMS HAVE BEEN MODIFIED IN CALIFORNIA.

These condensed statements of rather old methods of attaining the vase form with dwarf trees are given to show whence, perhaps, sprang the method now so generally adopted by our

growers of deciduous fruits. It will be in order to note some of the ways in which we adhere to, and some in which we have departed from, these models:—

First—Our growers very generally accept the idea of dispensing with the central trunk and follow it faithfully. There are, however, some in this State who advocate maintaining a central leader to a certain height, but not at all as an apex of a pyramid. It is doubtful whether such a tree could be made satisfactory, except in upper coast regions not liable to sunburn. For this reason the whole pyramidal design, which is elaborated so carefully elsewhere, is not seen in this State.

Second—We go farther than our prototypes, because as far as possible we banish the side leaders as well as the central leader. At each cutting we aim to get two branches from one, and as nearly as possible of equal vigor, so the California tree does not, except, of course, in occasional instances, show the outline of a leader from the bottom to the top, but there is a succession of branchings, turned this way or that by the skillful pruner, occupying available air space, distributing the weight so it comes more nearly over the center of gravity and at the same time knitting the fibers of the branch so that the weight of the fruit is well sustained. This style is shown in the accompanying engraving.

CALIFORNIA VASE FORM: SIX-YEAR-OLD PLUM TREE.

Third—It would not be possible, with some kinds of fruits, at least, for long side leaders to carry the weight of fruit which comes upon California trees, without props or lashings from leader to leader across the center—which, in fact, some growers who have trained their trees in that way have to adopt. The alternate is to grow these leaders so long that they can bend over in a curve and rest their outer ends on the ground—and this too is advocated as a good system by at least one grower in this State, but it would be fatal in some districts, as both tree and fruit would be destroyed by sunburn.

Fourth—The general plan is, however, as stated, arranging the shoots to occupy the space and to distribute the weight; or, as one has expressed it, "growing three or four trees from one root." This idea is, however, not allowed to go so far as to wholly close the interior of the tree, but to retain such degree of open interior as is found desirable. When the tree is laden with fruit, the weight naturally expands the top quite enough to admit the sunlight without exposing either the fruit or the branches to danger of burning. Thus it appears that instead of the true vase or wine glass, with hollow interior and thin walls, we have the general exterior outline of this model, but give a good part of the central area of the figure to bearing shoots, and thus secure a large bearing surface with well-strengthened supports. It is not difficult to find four-year-old peach trees trained in this manner carrying, without props, one hundred and seventy-five pounds of large fruit—the size secured by most resolute thinning early in the season.

Fifth—The growing of a considerable number of leaders, all starting from near the point where the tree was headed at planting, something as the ribs of an inverted umbrella, does not give a strong tree. The leaders crowd each other at the point of emergence from the stem, and when laden with fruit, sway outward and break off at this point. A vastly stronger tree is secured by starting but three or four branches from the low trunk and letting them emerge from different sides of the stem, and at different levels. Thus each main attachment to the stem has abundant room, and the wood enlarges symmetrically and solidly. The expansion of the top is attained by the branching which follows the cutting back of succeeding years. Starting too many leaders from nearly the same level on the stem has been the occasion of great losses of overladen trees, and quite a considerable recourse to strengthening up weak trees by running bolts through from side to side at the points where experience shows breakage is likely to occur. This can be obviated in most cases by better pruning, which tends to distribute the strain more evenly over the stem.

USE OF BOLT TO PREVENT BREAKAGE (LELONG).

HOW TO SECURE THE PREVAILING FORM.

For the benefit of the inexperienced reader, it will be well to illustrate the steps by which the form of tree found so generally desirable is to be attained.

CUTTING BACK AT PLANTING.—First cut back the tree just after planting, as shown in the engraving, deciding first at what height you wish your trees to form heads, and cut them all back as uniformly as possible, always observing that there is a bud just below the point of cutting. To preserve these buds the trees should be handled carefully while removing from the nursery and during planting.

If the tree has already grown laterals where the head is desired, three or four of these properly placed on the stem may be selected to form the main branches, shortened in to the sound bud nearest the stem, and other laterals, not desired to form the head, removed. If the laterals on the young tree start out above where the head is desired, as is generally the case, remove the whole top, as shown in the engraving. If there are no buds on the stem at the place where the head is desired, the choice must be made between heading the tree higher up, where the buds are, or cutting back without regard to buds, trusting to the development of latent buds at the right place, or to the growth of a shoot from below which can be cut back to form a head the following year. It is for this reason, among others, that planters prefer a yearling tree which has not branched, but has good buds all along the stem.

CUTTING BACK AT PLANTING (BARRY).

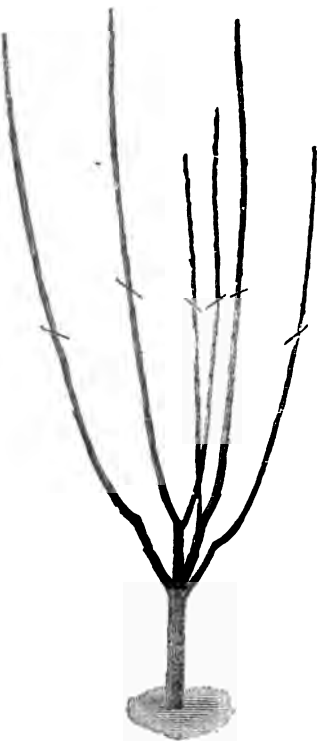
After cutting back at planting, the shoots desired to form the head are allowed to make their full growth without interference. All shoots not desired for branches are pinched off after growing out two or three inches, leaving a bunch of leaves to shade the trunk and contribute to its stouter growth.

TREE AFTER FIRST WINTER PRUNING.

FIRST PRUNING.—In the winter following planting, the previous season's growth is cut back to about ten or twelve inches from their junction with the stem. Some prefer to cut shorter, but this is apt to huddle the branches too close

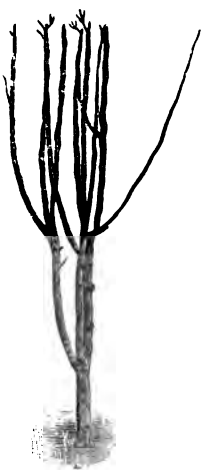
together when they get old and stout. Growers, however, do not agree on the exact length which these future main branches should be left at the first pruning. The engraving on the preceding page shows a tree with four main branches after its first pruning; in this case the branches are left rather long.

If, during the first summer's growth, all shoots except the number desired to form the head have been pinched back, the first winter pruning consists only in cutting back the main branches. If laterals have grown on the parts of these branches which are to be left on the tree, they should be cut back to a bud or two. This is better than removing them entirely, for the next summer they will be pinched, after throwing out a few leaves to shade and thicken the branches, just as the short growths left the previous summer serve the main stem.



CHERRY MARKED FOR SECOND WINTER PRUNING.

SECOND PRUNING.—During the second summer it is usual to allow two main branches to grow from each of the main branches left



PEAR TREE AFTER SECOND WINTER PRUNING

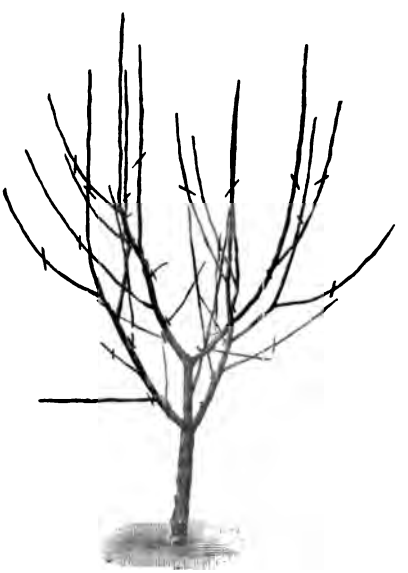
at the previous winter pruning, and to pinch off all others, as described. These main branches are allowed to run out their full growth, except where excessive growth is made, and then it is repressed by summer pruning. This is done with the

apricot in the warmer parts of the State, as will be considered at length in the chapter on that fruit. Usually, however, the main branches are untouched during the second summer's growth.

The engraving shows a young cherry tree in the writer's garden at Berkeley, which was cut back rather short at the first pruning, and is marked for cutting at the second. In this case four main stems were left, but from two of them only one branch each was allowed to grow. Usually a four-branch head is given eight branches the following year, but six are enough. If this tree had made other laterals, they would have been pinched in summer or shortened in winter as desired.

Another engraving shows a pear tree (with longer branches from the first pruning) after it has received its second winter pruning. The engraving is from a photograph taken in the orchard of W. W. Smith, of Vacaville.

A little different style of tree is shown in the engraving of a young apple in the garden of the writer, marked for its second winter pruning. The four branches forming its head emerge at a considerable distance from each other on the stem, and they are not quite at opposite points, as the engraving indicates. This form will give a stronger tree than where the branches all emerge from the top of the short stem, as is the case in some of the other trees shown. To arrange to have branches emerge at different points, pinching must usually be done, for it is natural for the buds near together at the top to push out strongly, and as the growth advances they assume about the same level. The markings on the tree may be suggestive as to the way to reduce an excessive number of laterals early in the life of the tree.



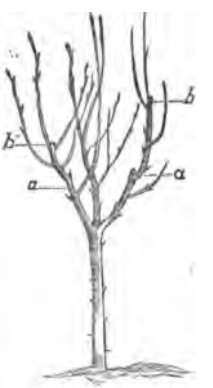
APPLE TREE MARKED FOR SECOND WINTER PRUNING.

THIRD PRUNING.—When the tree reaches its third winter pruning, its form is well outlined, and early-bearing trees like the peach and apricot will give the grower quite a respectable crop. To bear this crop greater care should be taken at the

third winter pruning to leave the small laterals low down on the main branches, for on them, clustered close in the head of the tree, most of the first crop will be found. Though some trees do bear earlier than the third summer, the fruit is not usually considered until the third summer. The engraving is from a pear tree in the orchard of W. W. Smith, the photograph being taken just after its third winter pruning. It is a very good representative of the vase form of a tree as grown in California. It has four main branches, each issuing from a different point on the stem, each permitted to carry two main branches, which are not arranged around the circumference, but some of them tending toward the center. At the third pruning more than the number of shoots have been left than required by the rule, for, starting with four main branches, there are usually sixteen left at the third pruning.

PEAR TREE AFTER THIRD PRUNING.

To show the relation between the prevailing California method and that described by Mr. Barry for the training of standards, it is interesting to introduce an illustration.* It shows a tree headed on three main branches, with two from each left at the next pruning. The points *a* and *b* represent the first and second prunings; although Mr. Barry prescribes that the growth shall be uniformly maintained between these six, the engraving suggests rather the formation of leaders and secondary branches, and does not show uniformity of strength in the branches, as does the California tree just described. The trunk is described as about four feet high, which is two or three times the height desired in this State.



STANDARD TREE READY FOR THIRD PRUNING (BARRY).

SUBSEQUENT PRUNING.—The method of proceeding thus illustrated is carried beyond the third pruning by some growers;

* "Barry's Fruit Garden," p. 222.

by others a different method is followed with some fruits, which will be specified in the chapters on the different fruits. Mr. Smith, of Vacaville, proceeds regularly year after year, and the engraving on page 158 is from a Silver prune tree in his orchard after the fifth pruning, or, if the cutting back at planting is called the first pruning, this tree has been pruned six times, and is six years old.

There has not been any effort made to definitely decide the lengths of growth to be left at each pruning, because practice varies in this respect, and the reader may choose his adviser from those whose practice will be next described.

LOCAL DETAILS BY PROMINENT GROWERS.

Having thus attempted to give imitation of the origin of our prevailing style of pruning, the respects in which the method has been modified in California practice, and prescribed the steps for its attainment, it will be well to show the wide application of the methods to our conditions by a few descriptions of the procedure of fruit growers in widely-separated parts of the State, the accounts being mainly in their own language. After citing these teachings of experience, a few general deductions therefrom will be indulged in.

General N. P. Chipman, of Tehama County, advises as follows:—

> Almost without an exception in this hot climate, all deciduous trees, such as apricots, peaches, prunes, etc., should be cut down within twelve inches of the ground after they are planted. I would prefer a head within six inches of the ground. Among my early plantings I can show trees with a clean trunk of four or five feet, and I shall keep a few as monuments of my ignorance; the balance I shall cut down and grub out. Leave three or four buds at the top of your tree, and don't worry if the first year some small branches come out all along the trunk: they will help to shade your tree and you may have to use some of them in balancing your head next spring. As a rule, your tree will need no knife the first summer, and while shading the trunk with a board is wise, still by cutting low the foliage will amply shade the tree.

The late Dr. S. R. Chandler, of Sutter County, at a meeting of the State Horticultural Society, in February, 1885, said that he cuts the young tree down to about six inches from the ground, instead of fifteen to twenty inches, as advised by others. Instead of checking the growth of any of the shoots during the summer, he lets them all grow, and considers that the trunk is thickened and strengthened by the action of all the leaves which are allowed to develop. After the leaves are off, he prunes out the shoots which he does not need. Since his death, the trees begun in this way have been carried along on the same plan by his successor, Mr. R. C. Kells, and have been pronounced favor-

ably upon by other growers who have visited the orchard, near Yuba City.

W. W. Smith, of Vacaville, Solano County, is recognized as one of our most successful trainers of fruit trees, and his addresses on the subject before our State Horticultural Society have done much to educate younger planters. The following is an outline of Mr. Smith's method:—

The top of the tree should be cut off after planting out (not before) down to fifteen inches above the ground. Three buds at the top permit to grow; three limbs are better than four or five. When the twigs below start out a little way, pinch off the terminal bud. Twigs thus pinched off put out a few leaves and shade the trunk. In the pruning season the following winter, cut off the three branches, so as to leave them about twelve inches long from the trunk, and allow each of these three to send out two shoots, pinching off all others soon after they start out as twigs. At the next winter's pruning, or the third year of the tree from the bud, cut off these six branches to eighteen inches in length. Each of these six are allowed to put out two shoots, and the other buds are pinched. Then, the next year, the tree has twelve main branches, and has assumed a goblet shape, and is symmetrical, if care has been taken to pinch all twigs except those mentioned as left to grow. The pinching of twigs may be done during the growing season, and it will be found that this summer pruning will save much cutting of wood at the regular winter pruning. By pinching an undesirable bud the moment its nature is detected, the sap which it would use in several months' growth would be saved.

Professor Charles R. Paine, of Lugonia, San Bernardino County, gives the following as his practice:—

I train the stem to a single stem in the nursery, and just after planting I cut them all off at a uniform height, 12 inches. When the young growth, which will appear chiefly from latent buds on the remaining lower part of the stem, is a few inches long, I select from three to five shoots—preferably three in the peach—near the top, leaving a space of several inches between them, and pinch back all the others below, forming a tuft or rosette of leaves, whose presence will aid in the development of the young tree, and serve to shade the trunk. I repeat this work several times during the season of growth, and it is a very speedy operation. The following spring I cut back these three shoots to stubs, and not all of the same length, but varying from four to eight inches, for the double purpose of making these limbs stocky to bear their future burdens of fruit and of controlling the shape of the tree. Shortly a quantity of young growth will cluster about each of these short stubs, which can be thinned out by thumb pruning to two shoots to each of the three branches, tending obliquely upward from inside buds mostly; these will make lusty growth, which should be cut back to about 12 inches. The next season the branches should be shortened to about 18 inches, and every succeeding winter the wood grown the previous season should be pruned back at least one-half, as well as such branches be removed as impair the symmetry of the tree, and threaten to overburden it with fruit, and likewise those that may start to grow in a somewhat horizontal direction outside the three main branches and their prongs.

In the third year the tree has attained the shape it is ever after to keep—a short trunk less than one foot high, having no central stem beyond, and from along its summit branches divergent at an angle of about 30 degrees, strong to support their destined weight, not declined so as to interfere with your work of cultivation, and not needing to be removed, as would be the case when age and length and many annual loads would bear downward branches supported on one long central trunk.

The fruit producing spurs have ever a tendency to grow up and beyond reach, and for this reason the heavy cutting back of the first two years was done to bring the fruit wood nearer the base of the tree, and the aim should be to keep it there, not pruning the prongs of the tree clean, but thinning out so that the branchlets may

not die, and shortening the remainder, that fruit buds may form. These fruit spurs along the larger branches of the tree should be left on prune and aprico. trees especially. The main trunk of the prune and apricot could well be grown four inches longer—that is, 16 inches—to afford room for the attachment of the main forks, for in the prune there should be a greater number of prongs, and in the apricot the limbs should grow out so independent of each other that there may be little danger of splitting down, as the brittle character of its wood tends to make it.

J. W. Sallee, of Pomona, Los Angeles County, read an admirable essay before the meeting of the County Pomological Society, in April, 1886, in the course of which he said:—

The best method to secure a low head is to cut the trunk off within sixteen inches of the ground. Cut all branches off—not smooth with the trunk, but leaving a very short stub—just the bulge or base of the branch. This is to secure the more healthy buds which put forth near the base of the old branch. You will be much more certain to secure good, healthy branches in this way than you will to cut smoothly. Allow five or six of these healthiest branches to grow, seeing that the head is properly balanced. Do not grow them too near together at the top of the trunk, but distance them within ten inches of the top. Remove all other branches within this distance with your hands while they are quite young. All branches below the head should be allowed to grow about six inches long, then pinch out the bud, allowing the foliage to remain. This protects the trunk until the head is large enough to do this, when these small branches must be cut off. You should allow the four, five, or six branches which form the top, to grow uninterruptedly the first season. The following winter cut these branches off within ten or twelve inches of the trunk, being careful to cut just above a series of healthy buds. If the tree is an upright grower, cut to an outside bud, but if a spreading grower, cut to an inside bud. At all times have an eye to the protection of the tree from southwest winds and sun. The second season allow two or three branches to grow from each one of the parent branches. You thus have a handsome, symmetrical tree, and your after pruning is suggested by the foregoing. When branches begin to decline, they should be removed, and after the tree begins to bear, the pruning should be much more sparingly done, if fruit is the object.

LOW HEADING WITH CENTRAL STEM.

It will be noted that in all these cases there is no provision for a central stem. The departure from this practice, which prevails to some extent, and generally in the cooler parts of the State, proceeds upon low training, but provides for a leader. For example, Mr. A. Loomis, president of the Santa Cruz Mountains Fruit Growers' Club, gives the following as his method of training:—

I would start a tree with three or four branches, one and a half to two feet from the ground, as a framework from which to form the head, leaving a center shoot, if possible. These I would cut back to about one foot, leaving the terminal bud on the upper side of the side branches to continue growth in an upward direction. These will, during the growing season, make usually two to four lateral branches, which I would again cut back, thinning out where necessary, always endeavoring to preserve a round, upright open head. By practicing this system until the tree arrives at a full bearing condition, very little pruning will thereafter be needed, except to cut out sprouts from the center of the tree, and occasionally to thin out the top branches, if inclined to grow too thickly, or cutting back shoots which are inclined to grow too long and destroy the symmetry of the head. I would use this system with apples, pears, and cherries *especially*. With trees thus treated, it will seldom be found necessary to remove large limbs, which I would avoid as far as possible, except in case of a tree that, from some cause, has become diseased or enfeebled in growth, when it would be well to cut back severely the old wood, reducing the head to give it a chance to recuperate and send out a new growth of healthy wood.

The following method is advocated by a Humboldt County grower:—

Have young trees to begin with. Instead of cutting the top or center out, as is often done, always let it grow as straight as possible. The top or center is the tree, and should never be cut off unless it grows too fast; then it should be cut back to a suitable length, always leaving a bud in the wind side to continue its growth, as needed. Next are the fruiting branches, which should come out near the ground or as high or low as you wish. Next you must thin out the branches if too many, and shorten them by cutting back if too long. By following this plan every year you can have as fine-shaped trees as anyone can desire, and they will not break or split when loaded with fruit, so easy as a tree without a center.

Isaac Collins, of Haywards, gives the following, as prevailing, to some extent, at least, in his important region:—

The young tree, on being planted, is cut back to within three feet of the ground. When the buds attain a growth of two or three inches, a selection is made of the best four buds, the first as close to the top as possible, the second four inches below, the third four inches below on the reverse side, and the fourth the same distance below, also on the side opposite to the previous one. Below this there is a stem of two feet to the ground without branches. On the two feet of stem the leaves from buds are permitted to grow to shade the trunk, and shoots that may attempt to grow thereon are pinched off. The four selected shoots are allowed to grow without meddling the full season's growth. At the winter's pruning of the four shoots that are to form the head of the tree, the upper one is cut back to four inches, the second about the same, the third to five inches, and the fourth from six to eight inches. On these cut-back shoots, when the growth from their buds is about two inches long, a selection of two of the most suitable is made and the others are rubbed off on all except the uppermost shoot, from which the terminal bud only is allowed to grow. The second year the tree will have seven leading boughs to form its head, one of which will make a strong main stem. The leading boughs are cut close to that stem that they may have the greater weight-bearing power. The third year they can all be cut back to the length that is considered proper from the general conditions of the case.

GENERAL EFFECTS OF PRUNING IN CALIFORNIA.

Referring to the older treatise for the philosophy of pruning as related to the vegetative process of the tree, etc., the following considerations, based upon California observation and experience, are taken from the essay of J. W. Sallee, of Pomona, to which allusion has been made:—

First—Close pruning, when the tree is dormant, induces tree growth. Hence, if your tree is feeble, or has not grown as well as you wished, trim it closely in the winter season, always cutting just above healthy buds.

Second—A severe shock to the tree—either top or root—while the sap is flowing freely, causes the tree to throw out fruit spurs and buds for the next season. This is from the fact that the law of nature is reproduction and the shock causes the tree to act thus upon the principle that this will be its last chance for reproduction. Pruning while the tree is in blossom causes that crop of fruit to set, upon the same principle. And likewise deep plowing—which is a system of root pruning—has the same effect. I do caution fruit raisers upon this point, however, for it is this motto that has caused many of the young trees in this country to bear far beyond their capacity, thereby injuring the young tree.

Third—When tree growth is desired, prune while the tree is dormant, and when fruit is desired, prune sparingly and when the sap is flowing.

Fourth—For plums, prunes, and apricots, leave all the small spurs growing near the trunk on young trees as well as old, for these are they which bear the fruit.

"Head in" well from the outside, which tends to fully develop these spurs, and also strengthens the tree, and causes the fruit to bear near the trunk.

Fifth—Apples, peaches, and pears are inclined to bear nearer the tips, and young trees should be well headed in in the winter season, both to give the tree symmetry and strength, and also to induce a more vigorous wood growth and prevent a premature bearing of fruit, which is too much the case in this climate.

Sixth—The principle is different in citrus trees. The fruit and foliage are both borne at the extremities of the branches, hence never head in a citrus tree, but as the tree develops, cut out from the inside all dead branches, and those which nature indicates past usefulness, at no time making an objectionable window or opening through the umbrella like foliage. After a small branch has borne fruit, there is another branch putting forth below this one which overreaches it, and which will bear fruit in the future. Nature thus prunes the old branches, but should be aided by the husbandman's knife.

Seventh—At all times remove all dead branches and branches that interfere. This should be done by making the cut smooth, which will more readily heal.

Eighth—The best time for pruning is immediately after the tree has shed its leaves in winter, which is the last of December or in January. This is with deciduous trees. For citrus trees any time is good while the tree is dormant.

Ninth—The best tools for pruning are a saw, working on a swivel and with a spring back similar to a butcher's saw, only set to cut as you pull towards you, and a pair of first-class nine-inch pruning shears; also a light chisel and mallet for smoothing rough cuts.

CONFLICT OF OPINION ON PRUNING.

Ever since the pomological experience of our ancestors in the Garden of Eden, perhaps, there has been a conflict of opinion about the necessity of pruning. California has fewer "non-pruners" than other fruit regions, however, because a fruit tree left to itself in this State soon becomes a wreck. Its exuberance in its early years, if it is in a good situation, tends to a long, straggling growth, which is unable to carry the weight of fruit which following years may bring upon it. Bending every way under this burden, it is torn to pieces by the wind, or else by very weight of fruit alone becomes, with its prostrate branches, a perfect picture of beauty in despair. Even if the grower provides himself with cords of props and posts to support the limbs, the sight may please the artist as a vision of profusion, but it does not delight the grower who knows trees may be built up in the strength to sustain all the really first-class fruit they should ripen. In less favorable countries, where wood growth is less and fruitage more scanty, it is natural that there should be more non-pruners than in California.

And yet we may be said to be drifting into rather more moderate ideas of pruning than have prevailed, but these relate rather to treatment of the tree after it has been given its proper shape; that is, to treatment after the full bearing period commences. There are some who advocate recourse to bending, staking, and tying branches during the formative process rather than cutting back and growing from a bud a new branch where

one is needed, and there is, perhaps, room for all the ingenuity and painstaking effort which advocates of such methods desire to put forth, but such practices are rather for the grower who has plenty of time and comparatively few trees, and not for the commercial orchardist who has little time and many acres of trees. The whole process of fruit growing is to a certain extent an artificial one, as is the development of breed characteristics in animals, or keeping them under devised conditions for their products, and though the nature and behavior of the tree should be carefully studied, it is really what the fruit tree borrows from man, and not from the forest, which gives it its present value and characteristics.

SUMMER PRUNING.

Summer pruning to induce bearing is, as has been previously intimated, but little employed in this State, for the constant tendency of our trees is to bear early and to overbear, which, on theoretical grounds, at least, is accepted as indicating short life to the tree. Summer pruning to check the too exuberant wood growth of some kinds of trees is employed to some extent, chiefly in the warmer parts of the State, where the vegetative process in some trees seems fairly to run riot, and unless checked is apt to ruin the tree by breaking to pieces when the wind and weight of fruit test its strength. The methods of summer pruning employed in different parts of the State for different fruits will be considered in connection with the special chapters on these fruits.

Summer pruning to preserve form is another matter, and relates in the main to pinching in, to check undesirable extension and to direct the sap toward shoots in which growth is desired. This practice is approved by most of our orchardists, and is employed by them to a greater or less extent. More people believe in than practice it, however, because the summer months, with their long succession of fruits to be gathered and shipped or dried, and the additional consideration that there is always a scarcity of labor at this time, give the orchardist so much work to do that he is apt to confine his "pinching" to a little that he may do now and then when he has a few moments' leisure, than to do the work thoroughly and systematically. The result is that the regular winter pruning is the main operation for tree shaping in this State.

There is such a great difference in opinion about summer pruning that it will be very difficult to make any assertions about it which will not be disputed. Much of this difference comes, of course, from different conditions prevailing in different

trees and in different parts of the State, and some of these will be met, as already promised, in following chapters. Leaving these wholly out of consideration at this time, it is safe to advise those who wish to secure symmetry or any particular form in any kind of a tree, that they can resort to summer pinching with advantage, and can sometimes to advantage remove wood too large for the thumb and finger to sever. A few instances will be given and others will suggest themselves to the reader:—

Adventitious shoots starting out on stem or limb at points where branches are not desired, should either be rubbed off in the bud or should have the terminal bud pinched off when they have put out one or two pairs of leaves. The latter seems best, because in the young tree the leaves shade the bark, and if the tree is of bearing age the buds left will form fruit spurs. By this practice, of course, the cutting away of many large shoots at the next winter pruning will be avoided.

Suckers, which, properly, according to Downing, are "shoots sent up from the root or from parts of the stem below the surface of the soil," should be removed whenever discovered. This mention will also include the pinching of shoots when more are put out close together than are desired to carry on the form of the tree. If three start and but two are desired, the third should be pinched, and the result will be the stronger growth of the two remaining.

RENEWING OLD TREES.

Improving and renewing trees by cutting back and grafting has already been considered under the head of propagation. It is often desirable to renew trees of a satisfactory variety, and this is done simply by cutting back when the tree is dormant. Cutting back should be done early in the winter, before the rise of the sap begins, and the wounds should be most carefully pared smooth and covered with the protecting materials which have already been mentioned. In cutting back, of course, those stumps should be left to support new branches which will secure the best balance and symmetry in the new head. When the new growth starts, there generally appear many more shoots than are desirable, and selection of the best-placed and most vigorous should be chosen, the others either being rubbed off in the bud or pinched back when a few leaves are put out. In cutting back trees in the warmer parts of the State, the exposed trunk and branch stumps should be wrapped in old sacking, or otherwise protected from the sun, or serious burning is likely to take place.

In removing large limbs it is desirable that the cut should

be made in the right place so as to secure quick covering of the scar with new growth. Cutting so as to leave a long stub results in an unsightly piece of dead wood on the tree, and this, in decaying, carries the decay deep into the center of the trunk or branch. Cutting too close prevents covering with the new bark, and also results in a hole in the branch. Cutting just to the right mark, which is the outer edge of the little collar or swelling which will be found at the base of all branches, enables the wound to grow over quickly, and if the wound is properly treated when cut, there will be no decay, and the wound will soon be wholly obliterated.

Trees often become "hide-bound," as it is called. Especially in this dry climate the bark gets dry and tough, therefore cannot expand in proportion to the growth of the tree, or supply the amount of sap necessary for the demand. Slitting such trees here and there up and down the trunk and main limbs with a sharp knife seems to have good effect, for often in three months the cut opens half an inch, and a fine, clear bark, with an increase of growth, results. On old trees, too, there is often a growth of moss and lichens which should be removed. This can be done by scraping off the rough, loose bark and spraying with an alkaline wash such as will be described in the chapter on injurious insect. This will remove the objectionable growth, give the trees a clean, bright bark, and, probably, contribute to their vigor as well as to their appearance.

PRUNING TOOLS.

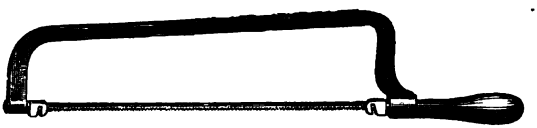
It is designed to give, in connection with the chapters relating to the different fruits, some account of special practices in pruning which are found to be most successful in different parts of the State. Certain other considerations which relate to the practical operation of pruning in general may now be submitted.

There is some difference of opinion as to the comparative value of the pruning knife and the pruning shears. The knife, if sharp, and well used, makes a smooth cut, with no bruising of the bark, and such a wound heals over perfectly. The shears, if of good pattern and sharp, also make a very good cut, but there is always some little injury to the bark on the side opposite to the entry of the blade. On small cuts, say three-quarters of an inch or less, if the blade is kept very sharp, the resistance does not make sufficient injury to the bark to seriously consider, and the speed with which the shears can be used renders them the main reliance for all the smaller pruning. Where much harm is done to the bark, the wound should be pared smooth and the bark be left sound all around to facilitate the healing-over process. Nearly all styles of hand shears are used in this State.

There are, also, two-hand shears, which are very powerful, and enable one to work very quickly. The objection to them is that lopping is so easily done that one is tempted to leave large cuts unsmoothed with the knife, while if the saw is used, paring is more likely to follow. This objection applies, however, only to the abuse of the implement. When rightly used, it is a very effective tool. There are a number of styles in use, both home-made and imported.

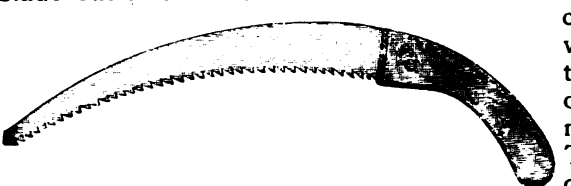
Still another arrangement of shears is mounted on a pole, the cutting blade being operated by a cord, and having a spring to throw the blade back. The pole is jointed, so that one or more lengths can be used. With this device one can stand on the ground and shorten in the top shoots of a tree very handily.

For larger cuts than can be made with the pruning knife or one-hand shears, there are pruning saws of different styles, of which the two shown in the engravings are of California design and construction, being made by the Pacific Saw Company, of San Francisco. The frame is made of the best spring steel, con-



CALIFORNIA PRUNING SAW—STEEL BACK.

structed somewhat on the principle of a butchers' saw, with the exception of the saw blade being much narrower; and instead of being stationary, it revolves so that the pruner is enabled to adjust the blade to cut at any angle, as is often necessary to do when cutting where limbs grow close together, and where it would be impossible to use an ordinary saw of a wider blade. The blade is only one-fourth to one-half inch wide, and therefore not liable to get pinched in the cut. Strength is imparted by a tension screw under the handle, which tightens the blade. The blade is easily detached by slackening the tension screw, and lifting the blade out of the slot in the clutches at each end. The blade can be thus reversed and made to cut with a push or a pull, as may be desired. The operator can carry this saw swinging on the arm while he is using his knife in paring cuts or trimming small limbs, thereby saving much time and annoyance in finding a place to put his saw when he wishes to use his hands with the knife.

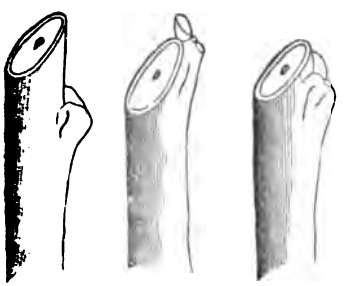


CALIFORNIA CURVED PATTERN PRUNING SAW.

The foregoing saw is commonly called the Hatch pattern. Another similar to it, except that it is heavier and has a handle like that of a butcher's saw, is known as the Jessup pattern. Another popular saw is the curved pruning saw, with twelve and fourteen-inch blades. As the engraving shows, the saw cuts with a pull.

CUTTING TO A BUD.

Whatever may be used to make the cut, it is important to sever the twig or shoot at that distance from a wood bud which gives that bud the best chance to grow well, and at the same time facilitates the healing and complete obliteration of the scar. Cutting too far from the bud leaves a stub which dies back, and is likely to carry decay into the pith and thence down into the limb. Cutting too close to the bud or carrying the slope down too far behind it, does not give it enough live wood to carry it, and it makes a weak growth. The accompanying engraving shows the right way and the wrong way to cut to a bud. In the first figure, the cut is too far from the bud; in the second, too close to it, and in the third the cut is made at the right point.



CUTTING TO A BUD (BARRY).

Cutting to inside buds with trees of spreading habit, and to outside buds with upright growers, has been mentioned. It is absolutely necessary to study the habit of the tree to prune intelligently. This idea will be enforced in the suggestions for pruning the different fruits.

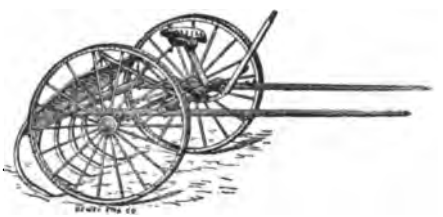
COVERING WOUNDS.

Whenever wood is cut with so great diameter that it will not grow over in one season, the wound should be coated with something to keep the wood from checking and decaying. The old prescription of shellac solution—alcohol in which gum shellac is dissolved until the liquid is of the consistency of ordinary paint—is very satisfactory, and the solution should be kept in a tightly-corked, wide-mouthed bottle; the brush may penetrate the cork, and thus the preparation will be always ready. Instead of this, ordinary paint may be used.

GATHERING UP PRUNINGS.

Gathering up prunings for burning is a tedious task and quite an item of expense. The late Mr. E. M. T. Hilgard, of

Berkeley, invented a machine for gathering even the most refractory prunings by the aid of the horse, leaving the material massed for burning. Preliminary tests of the invention have yielded very satisfactory results in vineyards where the vines are pruned to a head at some distance from the ground, but not with vines pruned low, as is the practice especially in the raisin districts of the interior.



HILGARD'S GRAPE-BRUSH RAKE.

Treatment of orchard and vineyard prunings with a view to the return of their substance to the soil, will be described in the chapter on fertilizers.

CHAPTER XIII.

CULTIVATION.

IT was demonstrated very early in California experience in fruit growing, that "clean culture" is the proper treatment for trees and vines. Though the frequent stirring of the soil and the complete eradication of grass and weeds have been advocated by certain horticulturists for generations as the true practice, it has nowhere secured such wide adherence as in California. It may even be held to be an essential to successful growth of tree and vine in California, and this being the case, it follows that the advantages of clean culture, which have been urged elsewhere, are intensified under our conditions.

Chief of these advantages is the maintenance of the soil in a condition favoring root growth, this being *sine qua non* of tree growth and fruiting. The main feature of this condition is the retention of moisture, and the way this is secured by thorough cultivation is worth a moment's notice.

RETAINING MOISTURE BY CULTIVATION.—It is a familiar fact that water will rise in a tube of exceeding small diameter very much higher than the surface of the body of water in which the tube is held upright. The water rises by what the physicists call *capillary* attraction. A compact soil has extending through it minute spaces, formed by the partial contact of its particles, which facilitate the rise of water from moist layers below, in accordance with the same principle which causes the water to rise in the capillary tube. This movement is constantly going on in a firm soil, and as fast as the top layer is robbed of its moisture by evaporation, the water from below is drawn up and it too is evaporated. During a long, dry summer, the water is drawn up and evaporated from a depth of several feet in some soils, and the earth, beneath the baking sun heat, becomes "dry as a brick."

When a soil is broken up by cultivation, its capillarity is temporarily destroyed through the disturbed layer, because the particles are so separated that the mutual connection of the minute interspaces no longer exists. But if it be but roughly broken up, so that the disturbed layer takes the form of coarse

clods, the air has free access to the upper surface of the firm soil beneath them, in which the capillary condition still exists, and evaporation proceeds in the same way, though in a somewhat less degree, than if there had been no cultivation. It becomes evident, then, that the pulverization of the disturbed layer must be so complete that the particles are separated and capillarity destroyed, and, farther, that the free access of air to the lower point, where capillarity exists, must be prevented. When this is done, only that moisture in the upper surface which comes in immediate contact with the air is evaporated, and the balance is retained for the use of the plant. Plants growing, then, in a well-cultivated soil, have the water in the lower soil held for their use, and as fast as they use it the supply is replaced by capillary attraction in the firm soil below; or else, evaporation being stopped, their roots extend freely through the moist soil, seeking the nourishment they need.

Such is a brief outline of the theory which explains the results gained by thorough cultivation of the soil, so far, at least, as retention of moisture is concerned. The practical demonstration of this retention is easy. Go into a well-cultivated orchard or vineyard, push aside the soil with the foot, and moisture will be found two or three inches from the surface, or even less in some soils, while on uncultivated land adjacent, digging to the depth of several feet will show nothing but hard earth, baked and arid.

In such hard-baked earth, moreover, the sun heat is conveyed or conducted downward very rapidly during a hot day, so that in some cases the roots are actually baked, and very frequently are seriously injured in their vitality. When the surface is well tilled, it will act like a blanket, preventing a too rapid conveyance of heat downward, and thus also diminishing the intensity of evaporation. When a crust is allowed to form, it acts like a sheet of horn; it conducts the heat freely, but, unlike a sheet of horn, the crust also sucks the moisture upward and allows it to be dissipated.*

EXHAUSTION OF MOISTURE BY WEED GROWTH.—But the pulverization of the surface is not the whole of clean culture. The moisture saved by arresting surface evaporation must not be lost by allowing thirsty grass or weeds to exhaust it. No exact experiments have been made to measure the loss of moisture by the two agencies, evaporation and weed growth, in this State, but the results attained by experiments in other parts of the world, which have neither the dry air nor continuous sunshine of California, are sufficiently startling to show why

* Professor Hilgard, letter to General Chipman, *Pacific Rural Press*, May 26, 1888.

clean culture is so important in California. Professor S. W. Johnson, director of the Connecticut Experiment Station, cites* experiments by Eser, showing that under similar circumstances, during a month of summer weather, the loss of water from a soil covered with growing grass was nearly two and one-half times greater than that lost from naked soil; also that evaporation from a hoed soil was only four-fifths that from a hard surface. Recent experiments in Illinois warranted this conclusion: The water saved during a week on an acre of land by cultivation, would, at the rate shown by the experiment, be seven thousand gallons, or would be equal to about one-fourth of an inch of rainfall.†

RAPIDITY OF EVAPORATION.—Still more impressive are figures recently cited by Judge Kennedy, of the State of Washington and commented upon as follows.‡

Resorting to a table of annual mean evaporation for a period of ten years, at a point in England, I find the loss of moisture for the following months to be as below:—

January	0.95
February	1.01
March	1.77
April	2.71
May	4.11
June	4.25
Total	14.80

From June to the end of the year the evaporation there, as here, decreases rapidly as the weather becomes cooler and the year draws toward a close.

An examination of the above table will show with what rapidity evaporation increases as the season advances, even in a climate so moist and cool as that of England, and reflection will convince anyone that while the ratio of evaporation in the State of Washington may be about the same, the actual amount evaporated from the soil in the spring and summer months will be much greater. Then, again, it is to be remembered that in all the above months, except one or two, the rainfall, in England, very nearly balances the evaporation, while with us it is almost all loss, with a comparatively small amount of gain, so far as rainfall is concerned.

Even these considerations do not fully describe the surface evaporation from California soil. But years of observation here indicate that this great loss of moisture can be easily arrested, and that the amount of evaporation from a well-cultivated soil is but a very small fraction of that from a hard surface. Perhaps the simple fact that our orchard trees grow so marvelously with thorough, clean culture, and are ruined so rapidly by neglect, is as forcible proof as can be had of the need of the best possible orchard care and treatment.

One more consideration must be adduced,—that this conservation of moisture in the soil is not only the surety of a season's growth and fruitfulness, but is the safeguard against injury from the years of deficient rainfall which occur now and then in Cali-

* *Country Gentleman*, Nov. 5, 1885.
† University of Illinois, Bulletin No. 3, 1887.
‡ Walla Walla *Union*, March, 1887.

fornia. The moisture supply is equalized by this storage in the soil, and the liberal rainfall of one year is held over to supply the lack of the next. Of course, the well-cultivated surface is also well calculated to catch the water. While from a hard surface much of a heavy rainfall flows off quickly to a lower level before it can penetrate, a loose soil retains all that falls upon it, except the excess, which disappears by seepage or drainage.

It has sometimes been held by California orchardists that planting some tall-growing crop, like corn, so as to shade the young tree and the ground around it, is an advantage. This is a great mistake. Though some rich, moist soils may afford moisture enough to grow both the tree and the corn, it is a fact that in most cases the growth of the corn is made at the expense of the tree, and sometimes almost costs its life and thrift. It has been clearly shown by the researches of Professor Wollny,* that though shading ground by a leafy growth may make the surface layer of the soil moister, the lower layers are invariably made drier, and it is in these lower layers that the tree seeks its sustenance. The young tree should be shaded as has been described in the chapter on planting, and not by a growing plant.

GROWING CROPS BETWEEN TREES AND VINES.

The subject of all growing crops between trees or vines had better be disposed of in this connection. As a rule, it is safer to say: Grow nothing whatever between the trees if you desire the full success of the latter. As with all rules, this one may admit of exceptions.

Inter-cultures in orchard or vineyard may be allowed under certain conditions of the soil and the purse of the grower. If your soil is deep and moist and rich, and your purse is shallow and lean, you can earn the cost of planting and cultivation, and sometimes more, by growing a crop among your young trees. Of course, if you irrigate you can do much more in this direction than if you trust to natural supplies of water.

There is much difference as to crops in amount of injury they may do the trees. Growing alfalfa has been known to kill out an orchard. Grain is less dangerous, but still is objectionable, both because of exhaustion of soil and moisture, and because of danger to trees from heat deflected from straw and stubble. The crops least injurious, because of their requirements, and because the constant cultivation of them retains moisture, are corn, beans, potatoes, beets, carrots, etc., squashes, and other members of the melon family, onions, and other shallow-rooting

* Cited in *Pacific Rural Press*, May 3, 1879.

vegetables. In the growth of these, however, there should be a width of four feet of well-cultured soil on all sides of the tree, unoccupied.

In soils exceptionally rich and deep, and where rainfall is abundant, as in the Haywards region, of Alameda County, or in the Vacaville district, of Solano County, inter-cultures of small fruits or vegetables may be carried on for a long series of years with profit both from the trees and the inter-culture.

In similar deep, rich soils with irrigation, as in the moist region of Santa Clara County and elsewhere, immense crops of small fruits and vegetables, even as high as twelve to twenty-four tons of tomatoes per acre, have been taken from between orchard rows, and one hundred and fifty sacks of onions per acre from between the rows in a strawberry plantation.* In Ventura County the best land for apricots is likewise the best land for Lima beans, and some fields of Lima beans in favorable years have paid over $70 per acre—grown between young trees.

HOW EXHAUSTION BY INTER-CULTURE MAY BE AVOIDED.

But all inter-cultures are a loan made by the trees to the orchardist. The term may be very long and the rate of interest very small in some cases, but sooner or later the trees will need restitution to the soil of the plant food removed by inter-cropping. How this return may be promptly made and still give the grower the income which he may need from the ground between his trees is shown by the practice of D. Edson Smith, of Santa Ana, Los Angeles County. According to his own account,† he came to California a poor man, and, after buying ten acres of unimproved ground, a horse and cow, tools and trees, his money was exhausted. He took from between his trees the frugal livelihood for his family of four persons. He says: "Some object very decidedly to doing this. But I hauled manure from town and have put back more plant food than I have taken away, so that the ground is in quite as good condition and the trees have made as good growth as if I had planted nothing between them." Mr. Smith irrigated his ground and manured it liberally. With such practice, inter-culture is, of course, admissible.

Notwithstanding these exceptions, the rule that the trees or vines should have all the ground is generally true. It is also true that on merely ordinary soils, trusting to rainfall, or on shallow soils, trusting in part to irrigation, the trees or vines should have the full strength of the land and all the help which can be given them in the shape of thorough cultivation.

**Santa Clara Valley*, Oct. and Nov., 1885.
†*Rural Californian*, Nov., 1886.

METHODS OF CULTIVATION.

Returning now to the subject of clean culture, it may be remarked that there are two main divisions of practice in this State, each of which has variations of greater or less importance.

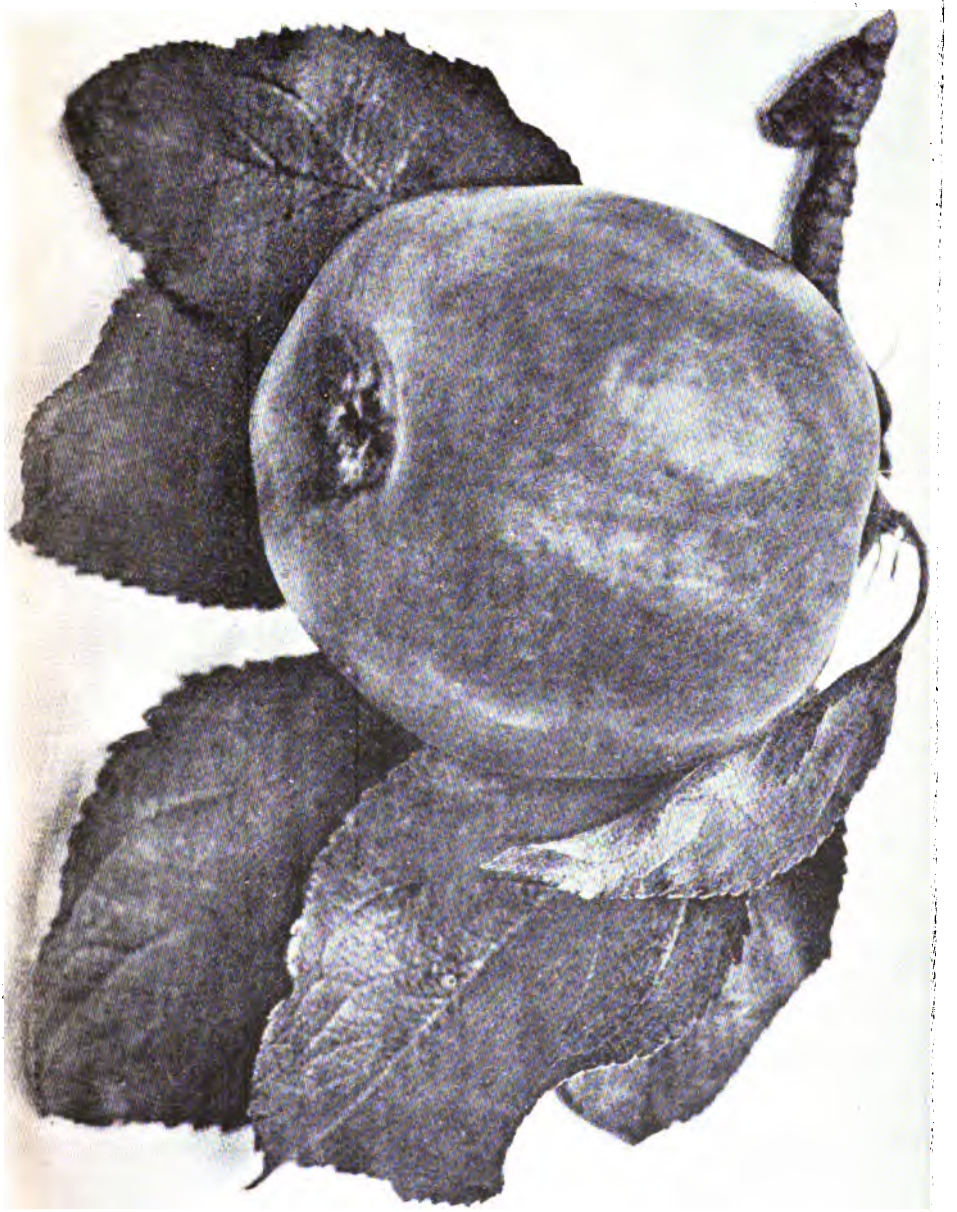
First—Winter plowing followed by frequent use of cultivator and pulverizer in summer.

Second—Use of cultivator at intervals both winter and summer, following, if needed, with pulverizer in the summer.

It will not be attempted to render judicial decision as to the comparative merits of these two systems of cultivation. It is quite probable that each has claim to superiority under different local conditions. It will be enough at present to describe the main features of each division of practice, and perhaps to mention incidentally some of the claims by which each method is supported by its advocates.

PLOWING ORCHARD AND VINEYARD.—There is considerable variation in the practice of plowing orchard and vineyard, in the kinds of plows employed, and in the times chosen for the work. Some plow but once, toward spring, whenever the ground is in suitable condition; and, if there is much growth of weeds and clovers, a looped chain is run from the plow to the end of the evener to aid in drawing under the tall growth. Sometimes, however, the growth gets so rank before the soil is in condition to plow that the weeds are mown before plowing. Where but one plowing is done, the soil is usually thrown away from the trees and afterwards is leveled back by harrowing or cultivating. If this practice is adopted, care should be taken that the soil is properly returned about the tree roots, for injury is sometimes done by bringing the roots too near the surface, which is soon afterward intensely heated by the sunshine.

It is undoubtedly better practice to plow earlier, when the green stuff gets a good start, but is still not too high to turn under handily. In this practice the weed stems are not so woody, but they easily decay and act as a fertilizer. Where early plowing is practiced, it is usual to plow again when the second growth of weeds reaches the proper state in the spring. When two plowings are given, the earth is usually thrown away from the trees in the first plowing, and returned toward the trees in the second plowing. But this order is sometimes reversed in situations where rainfall is heavy and the soil retentive, for the dead furrow between the rows often acts as a surface drain to carry off surplus water, which is thus prevented from standing around the tree roots. In all modes of plowing it is desirable that before the summer heat comes, the surface be leveled as completely as possible.



Too much stress cannot be laid upon the importance of plowing when the soil is in good condition and not otherwise. To disregard this is bad enough in all soils, but it is a grievous mistake to work any of the clayey soils when they are out of condition. If too wet, they are puddled by the plow and dry down in hard clods, impenetrable by air, and even resist water itself for a long time. When clods are thus formed, it may require long effort to bring the soil back to a good friable condition. The cultivation of adobe is one of the problems of California agriculture. The more refractory it is, the more particular care is needed to take it when it when it is in proper condition to work. To work it when perfectly dry is simply impossible; and if it is plowed when too wet and sticky, it becomes hard, lumpy, and altogether unmanageable. The condition which favors best results by tillage must be learned by experience.

Another mistake, apt to be made where the orchard or vineyard is but one of the branches of a mixed farm, is to put aside the plowing until all the field work is done, and in some seasons the soil in the orchard has become so dry that it turns up in large clods, which are afterwards partially reduced by the harrow, but never put in the fine tilth which should be secured for the retention of moisture and otherwise to encourage the growth and productiveness of the trees.

BREAKING UP HARDPAN.

Those who advocate the use of the plow, claim several advantages for it. The chief is that more thorough tilth can be secured. In most, but not all soils, there is formed by cultivation an artificial hardpan at whatever depth the implement attains, if this depth be kept the same for many successive cultivations. This hardpan, in some soils, at least, becomes impervious to water and is otherwise an injury to the growth of the trees. It occurs in irrigated and unirrigated land alike, but probably is more quickly formed by irrigation. When continuous summer cultivation is practiced, the hardpan will be found at two or three or four inches beneath the surface, at whatever depth the teeth uniformly reach. The remedy is to plow in winter just below this hardpan layer and thus break it up, and then by the action of the air and rains it is reduced, and cultivation may proceed as before. Where the hardpan is formed by the plow, the ground should be plowed shallow one year and deeply the next, thus alternating from year to year.

GREEN MANURING.—Another advantage in the use of the plow is, as has already been mentioned, the turning under of the growth of weeds, grass, and clover as a green manure. Many

growers attach considerable importance to this, and some, who have orchards in which growth has been killed out by long cultivation, are seeking for a quickly-growing crop which they can sow with the first rains and secure growth enough to turn under with the winter plowing. This consideration may be farther presented in the chapter on fertilization.

PLOWING HILLSIDE TO PREVENT WASHING.—Where the slope of the land is sharp, there is much danger from washing during the rainy season, if the hillside is not terraced or furnished with ditches carefully laid out to carry the water down on a gentle grade. The old plan of plowing furrows one above another around the hill to check the flow and let the water down easily, is often found treacherous, because of the liability to collection of water at certain points and the subsequent breaking away and washing. Recently some of the foot-hill growers have adopted the plan of plowing furrows seven or eight feet apart straight down the hill in the direction of its deepest descent. The rainfall is thus distributed over the ground so that not much water is collected in any one place and the harm done by washing will not amount to much. There has been some experience favoring this method, but it needs further trial to determine its practicability under all conditions.

THE BEST PLOW.—For plowing orchards and vineyards many kinds of plows are used, including the ordinary one and two-horse walking plows, single and double sulky or riding plows, and gang plows of different kinds. In several of the leading fruit districts there are plows made in the local shops which are patterned to meet the different soils prevailing. Which is the best plow is a question which cannot be answered, it must be determined by local conditions, and the best way to get information is to consult the experienced cultivators of the locality.

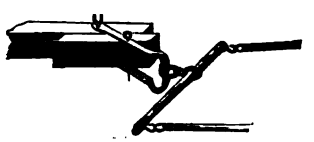
AVOIDING INJURY TO TREES AND VINES.

The great problem is to use the plow so as not to injure the trees and vines. Injury to the roots is one ground on which those who advocate the banishment of the plow from orchard and vineyard base their opposition, as will appear more fully presently. It is the usual practice to run the plow shallower when approaching the stem of the tree or vine, and this is easily done when using a riding plow or a two-horse walking plow between the rows and finishing up near the trees with a single-horse walking plow, which is a common practice. The injury by the plow to which especial reference is now made, is that to the bark of the tree or to the vine stump.

Makers of the special orchard and vineyard plows have re-

cently made them adjustable so that the plow will work either side of the central line of draft. Various methods of rigging the common plow and devices for disarming the ends of the whiffletree have also been widely introduced to enable the plowman to work nearly all the soil with the plow and still avoid the injury mentioned.

THE SIDE BLOCK.—One of the first appliances to come into wide use was that described by W. W. Smith, of Vacaville, and of which an engraving is given herewith. It consists, first, in having a singletree so constructed that the middle staple or clip will be further from one end than the other—say two-thirds of the way from one end. Second, place a block of wood, one and a half or two inches thick, on the side of the plow beam, at the end, and then turn the clevis outside of this block. This gives the horse an opportunity to walk straight forward without having his legs rubbed and chafed by the tugs, and thereby keeps him from becoming fretted and irritated. At the same time it gives the plowman a chance to bear his plow close up to the row of trees, while the horse can walk with ease at some distance from the row.



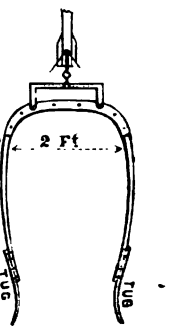
ARRANGEMENT FOR PLOWING CLOSE TO TREES OR VINE.

The drawing shows it arranged for turning the soil from the trees, the block being placed on the mould-board side of the beam. When wanting to turn the soil to the trees, it is simply changed to the other side of the plow beam, and the singletree turned over—that is, turned end for end. This keeps the short end of the singletree to the row of trees. A singletree about eighteen inches long is best—having one end about a foot or thirteen inches, and the other about five or six inches. The principal feature or advantage in the thing is the way the singletree is made. Some may think that it would not draw evenly on the horses' shoulders, and would consequently hurt the horses' shoulders, but such is not the case.

Though this served a very good purpose, it has been superseded in the Vacaville district by an iron attachment to the plow beam. It consists of an iron rod or bar so shaped that it can be bolted to the side of the beam, and it has several holes by which the clevis can be placed more or less to one side. It is strengthened by a brace running back to a bolt which fastens it to the plow beam just ahead of the standard.

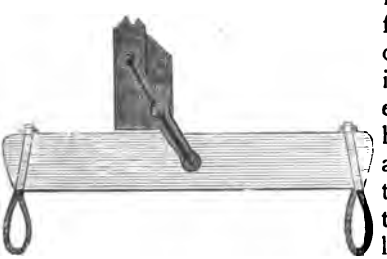
SIDE BLOCK AND SHAFTS.—Though these enable one to stir nearly all the land with the plow, there was still injury done to the bark of the trees and vines by the ends of whiffletrees,

and efforts to disarm the whiffletree were next made. One of the first was that of Robert Caughey, of Point Arena, Mendocino County, who used the side blocks, but also used an arrangement of his own device, consisting of a pair of shafts finished smooth on the outside so that there were no points to catch the bark. He found it very satisfactory, bending aside a tree it touched without injury to it, and obviating all trouble from the horse getting his feet over the traces. The engraving shows the home-made contrivance of Mr. Caughey. He riveted old traces to the end of the shafts and buckled them to the harness. It should, of course, be made longer or shorter to suit the size of the horse. The device as shown in the cut has the draft central; the short lines show how it may be carried to either side.



SIDE BLOCK AND SHAFTS.

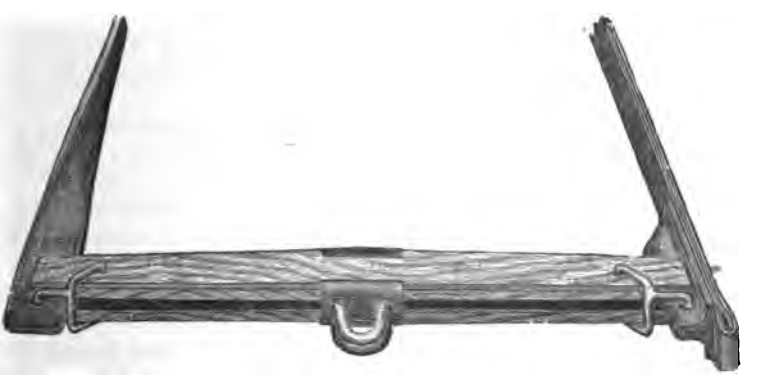
HOME-MADE WHIFFLETREES.—Another arrangement, also using the side block, is that of C. A. Wyman, of Santa Clara County, shown in the engraving. The whiffletree may be made of any stick of wood sixteen or more inches long. Bore a hole in the middle for the clevis pin, and two three-fourth-inch holes from the forward corners of the whiffletree at an angle toward the clevis. Work a loop in a three-fourth-inch rope and run the rope through the three-fourth-inch holes in the ends of the whiffletree. Tie knots in each rope, so as to let six or eight inches of the looped ends hang in front of the whiffletree, and cut the ropes off behind the knots. By putting the toggle on the trace into the loop from the outside, it leaves a smooth side toward the trees or vines and never comes unhitched while turning. The length of the loop saves changing the length of the traces when changing from double to single plowing.


WHIFFLETREE AND SIDE BLOCK.

W. Pfeffer, also of Santa Clara County, advocates the use of a whiffletree thirty-four inches long, and does not find it too long. He bores two holes, about six inches each side of the center. He also uses the side block already described. To throw the ground toward the trees he uses the block on the left side of the plow beam and the hole in the whiffletree on the right of the center. When plowing the ground away from the

trees, he uses the block on the right side of the beam and puts the clevis pin through the left side hole of the whiffletree. In plowing on side hill he uses a side-hill plow with a side block bolted on each side of the beam, and plows back and forth, always throwing the dirt downhill. Each time the plow is reversed the clevis pin is changed to the other hole in the whiffletree. By this arrangement the horse always walks in the furrow, the plow takes plenty of land, thorough plowing is done, and a very little left for the hoe.

FLAT HAMES AND A SPREADER.—Among the worst things for use among trees are the pointed iron hames which are found on most harnesses. They often seriously bark the branches under which the horse passes, and should be dispensed with. An arrangement used in San Bernardino County consists in having broad leather tugs and hames with only one long iron loop on the swell of the hame. The tug is passed around the hame and the end is brought through the iron loop from the under side, so that the draft will hold the tug tight between the collar and the hame and the end between the iron staple and the pulling part of the trace. A spreader is put between the tugs; it is made of a hard-wood stick sixteen to eighteen inches long; a hole is bored in each end large enough for a two-inch screw, a hole punched in each trace about twelve inches from the rear end, and the tugs are screwed to the ends of the spreader, and the ends of the tugs attached to the plow clevis. This gives no iron or wooden surfaces at all, either on harness or whiffletree, to strike the bark.



CALIFORNIA IMPROVED ORCHARD AND VINEYARD SINGLETREE.

IMPROVED SINGLETREES.—Later than these came the orchard and vineyard singletrees, invented and patented by

Californians. The first was that of G. G. Wickson & Co., of San Francisco, and it is now very widely used. As shown in the engraving, it is made in two parallel parts, the trace is slipped between the upper and lower halves, and there held by a simple clasp, leaving fully one-half extending beyond the ends of the wood, and preventing the singletree coming into contact with anything in passing, as shown in left-hand end of the illustration. With very young trees the edge of the traces *might* injure the tender bark, so a little supplementary trace is attached to the main trace at right angles, as shown in right-hand end of illustration, and passes between the ends of the singletree, presenting the flat side of the trace to obstructions, in which shape it cannot injure in the slightest degree the tenderest bark. The engraving is made with ends unlike to show both styles of hitching. There are other patented devices for preventing injuries to trees and vines which can be seen at the stores of dealers in agricultural implements.

DISPENSING WITH DOUBLETREES.—Still other inventions which admit the use of two horses even close up to the trees, because they dispense entirely with whiffletrees and tugs, are known as the steel harness, Eastern inventions, which have secured the approval of some of our leading growers for use in orchard and vineyard. The plow is attached to the steel yoke by a chain running between the horses. Mr. G. M. Gray, of Rancho Chico, says that with them it is possible to work quite close to the trees and vines, and is especially desirable in the vineyard in working close to the vines when they have grown out about two feet, which is a difficult job with the old-style harness.

SUMMER TREATMENT OF PLOWED ORCHARD AND VINEYARD.

Where the orchard or vineyard is plowed twice during the winter, the land should remain after the first plowing as the plow leaves it. The moistening and aeration during the winter has a good effect upon the soil both chemically and mechanically.

If but one plowing is done, when the chief rains are supposed to be over, there must be full effort put forth to reduce the soil to good tilth, and to level the surface as much as possible. This is done by harrowing with one of the several improved harrows which are now generally introduced and found very effective. They act in cultivating, clod crushing, and leveling, in a most satisfactory manner. They are too well known to need description. Each has its advocates and its adaptations to certain soils. As with plows, so with harrows and cultivators, the best

for one soil may not be the best for another, and local inquiry among experienced fruit growers will be the best guide for the newcomer. In addition to the excellent implements brought from the Eastern States, there are others of California invention and manufacture which have very marked local adaptations, and almost every fruit region in California has some embodiment of local inventive genius in the form of implements of tillage.

A new device for reducing plowed ground is the Lubin pulverizer, invented by David Lubin, of Sacramento. It is new in design and operation, and proved successful on the soil of its inventor, which is rather difficult of cultivation.

The secret of success in handling the heavier soils in spring working is to secure as perfect surface pulverization as possible without compacting the soil. Light soils need a certain amount of firming after plowing, or else there is too free access of air and too great drying out. For these and other reasons, the grower has to study his soil and learn from observation the methods which succeed best with it. The practice which gave success under certain conditions might not be well adapted under other conditions. The use of the roller is a striking example of this fact. In some orchards the roller is a benefit, in others a decided injury. Senator Routier, of Sacramento, once said, after a little experience with a corrugated roller, which would, no doubt, be found valuable on some soils, that he would not have it run over his orchard for a considerable sum per acre.

After the work incident to working down the soil after plowing, the cultivator is relied upon to kill the weeds, to break up the crust which may form after spring rains or after irrigation, and to prevent the compacting of the surface layer of the soil from any causes. This work is identical with the summer work of those who do not plow their tree and vine land at all, but trust to the use of the cultivator summer and winter, and that practice will now be considered.

CULTIVATION WITHOUT PLOWING.

There are orchards in California which have not been plowed for years—in some cases the plow has not been used since the trees were planted. Instances of this kind are to be found both in irrigated and unirrigated land. It depends largely upon the mechanical condition and disposition of the soil whether the practice will give satisfactory results. It cannot be trusted on land prone to develop hardpan, as has already been considered, and yet the term cultivation has taken such a wide range in this State, and the tools have reached such efficiency, that there is not much difference between the plow and the culti-

vator, except that the former turns the soil and the latter stirs without turning. For some who oppose the use of the plow, use a chisel-tooth cultivator cutting to a depth of eight inches in the spring, but at other times of the year they do not cut more than half as deep. This treatment would tend to dispose of hardpan. However this may be, and what the special nature of their soils, there are fruit growers both in Northern and Southern California who have for years trusted almost wholly to the cultivator, and who keep their orchards throughout the year almost in the same state of tilth, never allowing a weed to grow nor the surface to become compact. As a rule, these growers run the cultivator teeth but three or four inches deep, and in some cases trust almost wholly to flat teeth with sharp cutting edges, running a little below the surface and acting as weed cutters. The chief claims upon which this continued shallow culture rests are:—

First—That the surface is kept more even than when plowing is done, and a great part of the expense of plowing, harrowing, and leveling is avoided.

Second—That the injury alleged to be done by the plow to the roots of trees and vines, and the growth of suckers from trees worked on suckering stocks, are also avoided.

It is to be expected that the second point would be of considerable moment where surface flooding for irrigation is practiced, for this is always held to lead to the growth of many surface roots, but it has already been remarked that it is not alone on irrigated land that the practice is followed.

Without attempting argument on the wisdom of dispensing with the plow, it will be, perhaps, of interest to note the general principles upon which probably continued shallow culture rests, and the data is taken in the main from a lecture by Dr. S. W. Johnson, of New Haven.

A dry soil may be made too dry by deep and repeated tillage. The reasons are: *First*—By loosening, the soil is made to expose a vastly greater evaporating surface to the atmosphere than the compact soil presents. *Second*—The capillary connection of the loosened earth with the underlying soil is impaired and its power of taking up and distributing bottom-water is diminished. Thus the sources of supply are rendered less rapidly effective. To conserve the water of a loose-textured soil its main tillage should be shallow, so that the bulk of the earth remains compact enough to hold the rain and to transmit bottom-water steadily from the subsoil upwards to the roots of crops. The surface, only as often as it settles to compactness or forms a crust, should be loosened up again with the cultivator, so as to maintain over the water-conducting body of compact earth a relatively non-conducting layer of loose soil, to cut off the escape of moisture into the atmosphere.

Of course these general principles apply either to shallow plowing or to shallow cultivating, but more directly to the latter.

The essential point is in preserving the surface layer of *pulverized* earth. It will not do to have a few inches of clods from the size of a pea to that of a goose egg. The finer the pulverization the shallower can be the surface layer, and *vice versa*, and this is probably one reason why in practice the work of the plow is, in so many situations, found the best foundation upon which to rest the year's cultivation.

HOME-MADE RUBBERS OR DRAGS.

In order to secure this finely-pulverized layer, it is sometimes necessary to use what is called a "rubber," where there are many clods which are merely displaced by the harrow or cultivator. There are different styles, and they are generally home-made. The most common form is made of two-inch plank in lengths of three or four feet, bolted or spiked to pieces of four-by-four-inch scantling running crosswise, the edges of the planks lapped like the clapboards which they used at the East for weather boarding. As these edges are drawn over the surface, the clods are rubbed into tilth if they are not too hard and dry.

The following is another form with a device for use on hillsides, as described by a Santa Cruz County orchardist:—

I make the crossbars of round redwood poles about five inches in diameter. I put these about eight to ten inches apart, as where there are weeds this space is necessary to prevent clogging. It beats a roller or any other implement I have ever seen yet, and is cheap and easily made. If you have side hill to work on, take an old crosscut saw, knock the teeth off, and have some holes punched through and screw onto one side of the frame, the lower edge projecting between far enough to run into the ground. This will prevent sliding. I sometimes arrange the cross-bars diagonally to the draft line. I hook on with a chain, which leaves the drag free. This, of course, is for a riding drag.

Still another style with an attachment to prevent too great compacting and smoothing of the surfaces, which is not desirable, for reasons already stated, was described by J. W. Sallee, of Los Angeles County:—

After thorough cultivation both ways if land is heavy and inclined to be cloddy, follow immediately with a drag made of two four-by-four scantlings, four feet long, and framed together so as to rest with a corner of the scantlings on the ground. Have the scantlings about two feet apart. Have a small harrow four feet square made with six bars and seven teeth in each bar, the bars made of hard wood one and one-half inches square, and teeth of steel one-fourth by three-eighths inches. Fasten this little harrow behind the drag, and go over the land. The sooner this work is done after cultivating the better, as a fresh clod of dirt is much more easily pulverized than after it dries a little.

SUMMER CULTIVATION.

There is considerable difference in practice in the use of the harrow or cultivator during the summer. Some are content to

use the cultivator only as a weed killer, and after the weeds cease to grow and the spring showers are over, the cultivator is laid aside and the land is left unstirred until the following winter. This, of course, refers to unirrigated ground, for wherever irrigation is practiced, a cultivator must follow. It is a fact, however, that even if no rain falls, the soil becomes compacted to a certain degree, and the best way to imprison the greatest possible amount of moisture below is to run the cultivator at intervals of four to six weeks all through the dry season. It should run shallow and only stir the surface layer. This constant summer cultivation is certainly desirable in young orchards where the soil is exposed to the full sunshine, or where crops are grown between the trees.

WHAT IS THOROUGH CULTIVATION?

As clean, thorough cultivation has been approved, it may be desirable to attempt to define the term. It can, however, only be approximately done, because of the great difference in individual views and practices. The care of orchards by contract, which is a common method with absentee owners, does afford some measure of the work and its expense. The cost varies, of course, according to the character of the soil. In light loams, ordinary cultivation is usually counted as worth from $7.00 to $10 per acre, and cultivation with pruning of young trees at about $5.00 additional. An instance of a more complete cultivation is afforded in a contract which Mr. A. T. Hatch has made for 1889, for a large tract of young orchard on gravelly loam. The contract price is $12.50 per acre, and includes the following specified operations:—

First, plowing away from the trees followed by harrowing.
Second, plowing toward the trees followed by harrowing.
Ten summer workings with cultivator.
Three workings with shallow cultivator or weed cutter.
Five hand hoeings around the trees.

The contract intends the most complete and perfect working of the soil and specifies the above merely that there may be no difference of opinion between owner and contractor.

In cases where the land is infested with morning-glory, the rate per acre would be higher, for in such cases weekly cultivation is stipulated for in some cases, and this seems to be about the only way to cope with this formidable trespasser.

Contracts for planting and subsequent cultivation also include the filling of all gaps made by failure of trees at first planting, and the percentage of loss by good planting is usually so small that very little is added to the contract rate for that work.

MULCHING A SUBSTITUTE FOR CULTIVATION.

The use of a mulch or covering of the ground with a litter of light materials to prevent evaporation, is practiced to a small extent in this State. Though mainly used for berries of different kinds, recourse has also been had to mulching by vineyardists. The materials used are various, such as partly-rotted straw, coarse manure, damaged hay, corn husks, corn stalks, vine prunings and leaves, and even fine brush from adjacent thickets. The practice has been found of greatest value on hillsides where cultivation is difficult, and danger of washing of loose soil is great. There are cases where vines have been grown several years in this way to the satisfaction of the owner. The danger of fire in our dry climate when the surface is covered to a depth of several inches with a dry mulch is considerable. As a rule, the mulch employed by the California grower is a perfect pulverization of the surface soil, as has been described.

CHAPTER XIV.

FERTILIZERS FOR FRUIT TREES AND VINES.

CALIFORNIANS are but just beginning to use fertilizers in their orchards and vineyards. Some people have even held that California soils would never need fertilization, and that there is something in our soil and climate which releases us forever from repaying anything to the ground for the wealth of produce which we take from it. Such a view is, of course, without foundation, and yet it is not difficult to see how it arose. Early attempts to enrich the soil by the turning under of coarse stable manure, as is done in other countries, was undertaken here on light soil in a region of rather short rainfall. The manure did not decompose, and its coarse materials made a soil, already too light to retain moisture well, so open and porous that its moisture was quickly carried away by evaporation, and crops did not grow so well as upon adjacent land which had not been manured. The result was that people, always prone to jump at conclusions, at once set it down as a fundamental principle in our agriculture that "manure kills California soils," and the postulate from this was that California soil was ordained by the Creator to be fed upon some sort of ambrosia of sunshine and shower and zephyr, and would not need, in fact, would be sickened by, the strong food which the baser clay of the other parts of the earth's surface delights in. So the fiat went forth against manure. The corrals* became undisturbed guano deposits, and manure piles were fired in dry weather to get the soil poison out of the way. Innumerable tons of bones were gathered and ground in San Francisco and shipped away to countries which need fertilizers. Nature did much to foster the popular delusion, for field crops were gloriously large, and trees and vines grew rampantly and bore fruit the weight of which they were unable to sustain. How could there be more conclusive evidence that manure was a detriment to California soils?

It is foreign to our purpose to discuss the general subject of

*Inclosures for live stock of any kind.

the use of fertilizers in California, and the changes in belief and practice which have recently gained ground. Of course, the marked falling off in the yield of shallow-rooting cereals gave the first unmistakable intimation that there was something wrong about the old theory of the perpetual youth of California soils. The lands used for fruit will be last to show exhaustion, because trees are deep feeders, and the soils, as they are often the very best and deepest of the State, selected for fruit because of that very character, possess, in an eminent degree, lasting properties, as is shown in the chapter on the fruit soils of California. But certain of these soils are already showing the need of refreshment, and intelligent growers are quick to minister to the lands which are giving them such generous returns, as they can well afford to do.

WHEN IS FERTILIZATION NECESSARY.

Though the use of fertilizers by our fruit growers is beginning, it should be plainly stated that at present it is the exception and not the rule that such applications are necessary. There is reason to believe that we have some soils which are really too rich for fruit. There is sometimes an over-rank growth of wood, which delays or prevents the formation of fruit buds, and there is a marvelous development of fruit which is inconsistent with the highest quality. For this reason the grower should not conclude, from the foregoing general remarks concerning the need of fertilization in California, that he must manure his soil whether it needs it or not. Especially is this the case with young trees, in which the wood growth is easily overstimulated. As with irrigation, so in fertilization; the tree or vine itself will give the observing grower hints as to its needs, and if the growth of wood and color of foliage are such as obviously indicate health and vigor, it may be concluded that the plant needs nothing but good cultivation and intelligent pruning. If the wood growth on the young tree be excessive, there is the greater need of pruning to strengthen the trunk and main branches, and if this is done, the grower may be content to wait a little longer for his fruit, when he considers that he is building up a tree which will give him the greater weight of it when it does come into bearing. Of course this excessive wood growth may be checked by summer pruning, and the tree be earlier thrown into fruiting—a practice which has already been described as prevailing in some parts of the State.

Usually cases of over-rich ground will cure themselves as the trees attain size and full bearing, and it is then that fertiliza-

tion may be necessary. When the tree or vine which has been properly pruned and cultivated is not able to mature a good weight of well-developed fruit, and make a satisfactory wood growth, usually at the same time showing some degree of distress by the color of its foliage, it needs help; and if the grower is sure that the trouble is not from lack of moisture in the soil, he should bestir himself in the manuring of his orchard or vineyard. In examining the soil for moisture, one should dig deeply, for there have been cases of moisture near the surface, and drought below.

WHAT FERTILIZERS TO APPLY TO FRUIT TREES AND VINES.

A discussion of this subject from a chemist's point of view is beyond the scope of this volume. It may be stated, however, that California experience fully justifies the position that the most intelligent and economical choice of fertilizers is to be made after ascertaining by analysis in what constituents the soil is deficient and in what it is well supplied. In the chapter on soils there are numerous suggestions of this kind drawn from Professor Hilgard's work at the State University, and applications already made in conformity with these suggestions have proved very satisfactory. But as soils vary within narrow limits of area, there must be analysis for each soil in question. This is a more rational, and, as our experience shows, a more directly practical, method of procedure than to work backwards from the constituents of the fruit and base prescriptions upon such data without learning whether the soil lacks all these constituents, or, perhaps, only one of them, and already has the others in abundance. Analysis of the soil also shows, sometimes, that desirable materials are present, but in an unavailable condition, and that the use of a single cheap substance may set free others which can only be supplied otherwise by costly applications. It is upon this basis of direct and intelligent prescription that the use of fertilizers is beginning in this State.

And yet, though the constituents of the soil, as learned by analysis, must be the basis of prescription of fertilizers, the analyses of fruits, as showing the special needs of the plants, are of the highest importance. The following analyses of the ash of the different fruits, containing, in each case, skin, pulp, and seeds, are compiled from various sources, and are supposed to represent an average composition of the fruits named. The analysis of the wood of the apple tree is also added for comparison with the composition of the fruit:—

MINERAL CONSTITUENTS OF DIFFERENT FRUITS.

	Apple.	Pear.	Peach.	Plum.	Or'nge*	Grape.	Straw-berry.	Goose-berry.	Apple Tree.
Potash.....	35.68	54.69	74.46	59.21	48.94	63.14	49.24	38.65	19.24
Soda.....	26.09	8.52	.....	.54	2.50	.40	3.23	9.76	.45
Magnesia.....	8.75	5.22	6.29	5.46	5.34	3.97	8.12	5.85	7.46
Lime.....	4.08	7.98	2.64	10 04	22.71	9.05	13.47	12.20	63.60
Iron.....	1.40	1.04	.58	3.20	.97	.06	1.74	4.56	.07
Phosphoric acid.	13.59	15.30	16.02	15.10	12.37	10.42	18.50	19.68	4.90
Sulphuric acid..	6.09	5 69	.....	3.83	5.25	5.61	.....	5.89	3.29
Silicic acid.....	4.32	1.49	.....	2.36	.65	4.11	5.66	2.58	2.06

Of course these analyses only represent the mineral constituents in the fruit. Besides these there are organic compounds, the constituents of which are derived in part from the air, and in part from the soil. Nitrogen, in the form of some of its numerous compounds, is indispensable, but nitrogen has been found, both by practical experience and by scientific experimentation, to be a most active stimulant of wood growth and foliage, and to check fruit bearing when in excess. When the plant is in good growth it will have nitrogenous material enough to serve it also in fruit forming, and when special stimulants to fruiting are desired, care should be taken to give the plant ample supply of the substances shown in the ash analysis. This, as has been said, can only be done intelligently after ascertaining by analysis which the soil lacks.

Concerning the exhaustion of both mineral and nitrogenous materials by the different fruit crops, Professor Hilgard makes the following interesting statement:—

The subjoined table† gives some insight into the amounts removed from the soil by some of the chief fruit crops, of nitrogen, potash, phosphoric acid, and lime, these being, according to all experience, the only ones of which the replacement need ordinarily be considered in fertilization. These amounts are expressed both with reference to 1,000 pounds of fresh fruit, and to what, according to our best information, may be assumed to be a "fair crop" per acre. The latter figure is, of course, liable to great variations and differences of opinion; but by the aid of a little arithmetic, each one can calculate for himself the data suitable to his own case or views. The crop assumed in the case of oranges is 325 boxes per acre of 15-year-old trees; that of grapes is intended to represent a mean between uplands and lowlands.

It will be seen that for equal weights of these fruits grapes take from the soil by far the largest amount of mineral matter, of which nearly five-ninths is potash; they also carry off the largest amount of phosphoric acid. For seedless grapes the latter item would, however, be considerably smaller.

*Average of 9 ash analyses of California oranges, which show, also, chlorine .92%, br. oxide manganese .37%.

†The analyses of ashes here given are mostly those of European chemists, generally accepted as representing averages. The data for oranges are derived from many analyses of California varieties, at the Experiment Station Laboratory, Berkeley, Cal.

QUANTITIES OF SOIL INGREDIENTS WITHDRAWN BY VARIOUS FRUIT CROPS.

Fresh Fruit.	Total ash, lbs.	Potash, lbs.	Phosphoric acid, lbs.	Nitrogen, lbs.
Grapes, 1,000 lbs.	8.8	5	1.52	1.70
Crop of 10,000 lbs. per acre.	.....	50	15.20	17
Oranges (seedless) 1,000 lbs	6.07	2.78	.67	2.69
Crop of 20,000 lbs. per acre.	.....	55.60	13.40	53.80
Pears, 1,000 lbs.	3.3	1.8	.5	.6
Crop of 20,000 lbs. per acre.	.....	36	10	12
Plums, 1,000 lbs.	2 9	1.72	.44	4.2
Crop of 30,000 lbs. per acre.	.....	51.60	13.20	167.7
Apples, 1,000 lbs.	2.2	.80	.03	.6
Crop of 20,000 lbs. per acre.	.....	16	6	12

Next in the drain of total mineral matter from the soil stands the orange. It also draws heavily on the potash, and also upon the nitrogen of the soil, but less than the grape upon phosphoric acid; this independently of the seeds, the analysis having been referred to seedless fruit; seed-bearing (seedling) fruit would draw more heavily both on phosphoric acid and nitrogen.

Pears come next as regards total mineral matter, but draw quite lightly on nitrogen.

Plums (including prunes) are conspicuous chiefly for their heavy draught on the nitrogen of the soil, greatly exceeding in that respect the orange for equal weights, and enormously for an (assumed) average crop.

The difference between apples and pears in respect to soil exhaustion for an equal weight of fruit is quite striking, the amount of potash in apples being less than half, the phosphoric acid only a trifle over half as much as in the pear, while nitrogen is equal in both and quite low as compared to the orange, which has over four times as much, and must, therefore, be accounted relatively much more nourishing to man, as well as more exhausting to the soil.*

As a general rule, as shown by the examinations by Professor Hilgard, already mentioned in the chapter on soils, California soils are well supplied with potash and lime, and the minor constituents of the ash of fruits, also with humus, which Professor Storer aptly describes as "a reservoir of nitrogen," but that the materials most generally in smallest relative supply, and, therefore, soonest exhausted, are the phosphates.

AVAILABLE SUPPLIES OF PHOSPHATES.

Phosphatic manures are now being supplied to fruit growers by importers and manufacturers located in San Francisco, and results attained by their use are such as to warrant continuance. They are purchased by the car load by Riverside orange growers, and by vine growers in different parts of the State. They are ground bone, which furnishes both phosphoric acid and nitrogen in a highly available form, and rock phosphates, which are transformed into superphosphates, and, with nitrogenous matter added, also serv as good applications both for growth

*From University Experiment Station Bulletin, No. 88, on "The Use of Fertilizers in California."

and fruiting. There are immense supplies of these materials which will come upon the market when the demand warrants the extension of the manufacture.

HOME MADE BONE MANURES.—Much good bone manure can be made by collecting and storing all the bones from the house kitchen, or by gathering bones, heads, horns, feet, etc., from butchers' shops or elsewhere. How to make such material available, by simple proceedings, is described by Professor Hilgard as follows:*

1. Bones put into a well-kept (moistened) manure pile will themselves gradually decay and disappear, enriching the manure to that extent.

2. Raw bones may be bodily buried in the soil around the trees; if placed at a sufficient depth, beyond the reach of the summer's heat and drought, the rootlets will cluster around each piece, and, in the course of a few years, consume it entirely. But it will not do to have these root clusters broken up by cultivation every season.

3. Bones may be packed in moist wood ashes, best mixed with a little quicklime, the mass kept moist but never dripping. In a few months the hardest bones will be reduced to a fine mush, which is as effectual as superphosphate. "Concentrated lye" and soil may be used instead of ashes. In this process the nitrogen of the bones is lost, going off in the form of ammonia, the odor of which is very perceptible in the tank used.

For neither of these processes should the bones be burnt. The burning of bones is an unqualified detriment to their effectiveness, which can only be undone by the use of sulphuric acid.

4. Bones steamed for three or four hours in a boiler under a pressure of thirty-five to fifty pounds, can, after drying, be readily crushed in an ordinary barley-crushing mill, and thus be rendered more convenient for use. Practically, very little of the nitrogen (glue) of the bones need be thus lost.

Very good bone-meal is found in the market at reasonable rates.

POTASH.

Though, as already stated, potash is commonly in good supply in California soils, it is very desirable to guard supplies well, because, as the fruit analyses already given show, the use of this substance by fruit trees and vines is very large. Ashes from wood fires are the most available source of potash, but it is a mistake to regard wood ashes as valuable only for their potash contents. Professor Storer says:†

I have found by analysis of a number of samples of house ashes, that selected samples contain 8½% of real potash, and 2% of phosphoric acid, or say 4¼ lbs. of potash and 1 lb. of phosphoric per bushel. Hence there is enough potash and phosphoric acid to make a bushel of ashes worth twenty or twenty-five cents, and besides that, some ten or fifteen cents additional may be allowed for the "alkali power" of the ashes, *i. e.*, the force of alkalinity which enables ashes to rot weeds and to ferment peat. The notion that ashes from soft woods, such as pine or poplar, are worthless, is an error. The soft woods yield comparatively little ashes, and the ashes are so light that they may be readily blown away by the wind; but, weight for weight, the ashes from soft wood appear to be as good for agricultural purposes, or very nearly as good, as those from hard wood.

*University Bulletin, No. 88.
†"Agriculture," Vol. 2, p. 43.

But ashes may be very variable in condition. Stove ashes are, of course, the purest to be had. Lime-kiln ashes and brick-kiln ashes, as sold at the East, are found to be so laden with lime dust and brick dust that their value is less than half the estimate given for stove ashes above. Ashes from saw-mills or from burning of trees and logs should nearer approach the value of stove ashes, provided they are gathered without addition of earth. If straw is to be burned for the ashes, it should be spread out; straw burned in large piles forms ash which is fused by intense heat and becomes insoluble silicates.

These facts suggest to the fruit grower the direction in which to look for his potash. He should carefully preserve all home-made wood ashes and apply them to the soil at once, or, if stored for future application, be sure that they are kept dry. Leached ashes from the lye barrel, or ashes from open piles, leached by rains, are hardly worth handling. Coal ashes are almost devoid of fertilizing properties, though, if finely divided, as is the case of coals burning completely, their use is beneficial, mechanically, on clay soils, in the same way that fine sand would be.

Large supplies of potash salts are now brought from Germany, but there are extensive deposits in Utah, New Mexico, and elsewhere in the interior, which can be employed when railroads make them available.

NITROGEN.

Supplies of this substance can be had from barnyard manure properly decomposed, as will be described presently. Other sources of supply are described by Prof. Hilgard as follows:—

> By far the most convenient, and at present certainly the cheapest and most available, source of nitrogen at command of the farmer is Chile saltpeter, which contains about sixteen per cent of nitrogen, in its most effective form. From one hundred and fifty to two hundred pounds per acre is the usual dose.
>
> Sulphate of ammonia is the other most available source of nitrogen obtainable in commerce; a good commercial article contains twenty per cent and over of nitrogen. It does not, however, act quite as rapidly as the Chile saltpeter.

LIME, GYPSUM, AND MARL.

Lime is another substance usually abundant in California soils, but still often desirable as an application. This is, notably, the case on our heavy clays or adobes, where, as has already been mentioned in another connection, the use of lime as a top

dressing, at the rate of six hundred to one thousand pounds to the acre, not only makes the heavy soil more friable, but acts upon and makes available the large amount of organic matter which such soils usually contain. Lime also renders inorganic materials more available for plant food, corrects acidity, and may destroy insects and fungi. Application of lime is also desirable after applications of barn-yard manure have been made for several years; and it is especially valuable wherever, in alluvial soils rich in vegetable matter, there is an excessive growth of wood and leaf. Usually light soils are not materially benefited by the use of lime.

As to cost and supply of lime, the following is pertinent:—

In Berkeley, lime costs something over $14 per ton delivered on the ground, after deducting the value of the barrels. This might be considerably reduced, if large areas were to be limed, by buying by the car load in bulk. Many farmers are so situated that they can buy at the kiln at $6.00 or $7.00 per ton, or, perhaps, burn for themselves at a less cost. It is to be noted that stone which is not pure enough to make lime for mason's use, may do very well for the purpose in question. At kilns where first-class lime is sold there is usually a considerable amount of waste lime mixed with wood ashes, which is not used, and could be had at a trifling cost. Where clods have formed under careless cultivation, the benefit would probably be very apparent.

The kilns from which the central portion of the State is mainly supplied with lime at present are in El Dorado, Placer and Santa Cruz Counties, a moderate quantity being also burned at Los Gatos, in Santa Clara County. There are, doubtless, many other localities where the necessary supplies of rock and fuel could be had to produce lime cheaply, and of sufficient purity for agricultural use. The farmer should bear in mind, however, that, while he is improving the tilth of his stiff soil by the application of lime, he must look mainly to other sources for that plant food necessary to keep up its strength under continuous crops, and avoid ultimate exhaustion.*

Ground limestone is sometimes proposed as a fertilizer, and has ever been offered on the market. It is insoluble and inert carbonate of lime, and is not worth the cost of hauling any distance. It cannot take the place of burned limestone.

GYPSUM.—Gypsum, or land plaster (sulphate of lime), is a well-known fertilizer. It occurs in considerable quantities in this State and Nevada, and needs but fine grinding to be available and valuable. Its action in correcting soils made alkaline by presence of carbonate of soda has been mentioned in the chapter on soils. Applied to soils not alkaline, gypsum has been shown† to act by setting free potash, magnesia, and ammonia, which may be present in insoluble form; and it also causes potash to be transferred from the upper to the lower layers of the soil, so that roots can everywhere find a store of it. Hence its special value when applied to deep-rooting plants. The rea-

*C. H. Dwinelle, in Rep. Coll. of Agr., 1879.
†"Agriculture," by Storer, vol. 1, p. 207.

son why gypsum is so capricious in its action, which was long a mystery, is now held to be clear, because upon soils that are tolerably rich in fixed potash it will do good service, while upon soils poor in potash it will not. In any event gypsum is to be regarded as an excitant rather than as a form of plant food.

Of the several uses of gypsum, probably its chief value lies in its power as an absorbent. If added to manure in excess it delays fermentation, and it is, therefore, not a desirable addition to the compost heap. But for covering fermenting manures or scattering around moist places in horse and cow stables to absorb odors and fix volatile manurial substances it is of value. It is also valuable in hen houses and in earth closets. The following practice may be suggestive:—

Each of my poultry houses contains about twenty-five fowls. Some have floors of boards and some have bare earth. Immediately after each cleaning out of the droppings I sprinkle under the perches a bucket of gypsum. Twice a week thereafter I have sprinkled over the droppings a bucket of gypsum. This renders the house free from odor. I remove the droppings only when I want to use them—say once in two or three months. The compost formed by the alternate layers of gypsum and droppings does not, apparently, create any unfavorable effect within three months. If I do not wish to use the compost at the end of that time, I remove it then, because I would want to whitewash; and I put it in a pile under cover. Boards laid over it will do; or if in the dry season, merely cover with earth or more gypsum. This compost is convenient for use as a liquid manure, and is not offensive. I prefer gypsum to earth, because it is a good fertilizer in itself, and it also possesses, in a much greater degree than ordinary earth, the power to absorb the volatile gases, which are valuable fertilizers. Its cost in San Francisco is $13.40 per ton, free on board. I think every ton used in the way I have indicated has a value at least trebled, to say nothing of the effect it has in sweetening the atmosphere.*

MARLS.—Marl is a calcareous earth, and is called shell marl, rock marl, earthy marl, etc., according to its origin and mechanical condition. Good marl should become fine powder on exposure to the weather. It is valuable chiefly according to its percentage of carbonate of lime but often contains also potash and phosphoric acid. It is usually recognized by its whitish or yellowish color. A number of samples from different parts of the State have been analyzed by Professor Hilgard, and some of them commended for local application to soils needing lime, but not valuable enough to warrant hauling far. Though these marls supply limes to soils needing it, they do not act like caustic lime, as has been described. Sometimes the rock marl may be worth burning into lime for agricultural purposes.

BARN-YARD MANURE AND COMPOST.

Where fruit growing is carried on with stock growing, there are abundant supplies of manure available, but this combination

*B. C. Brown, in *Pacific Rural Press*, Aug. 18, 1886.

is not characteristic of California, though prevailing to some extent, and likely to be more prevalent as fruit planting extends farther from the centers which are wholly given to it. But even in the fruit centers there are certain amounts of material available from the animals that are kept for cultivation and hauling, or to be had, often, for the expense of hauling from adjacent towns. It is pertinent, then, to emphasize the fact that such manure should be handled intelligently to secure the greatest benefits from it.

It should be noted that manure from city stables which has been treated with disinfectants is thereby prevented from rotting and from exercising fertilizing effects as well. Carbolic acid will escape by exposure to the air. Salicylic acid must be removed by water. Composting such manures with wet earth will in time effect their decomposition.

As already stated, coarse, unrotted manure cannot be used to advantage in this State unless it be in heavy soils in regions of heavy rainfall, and even in such situations either finely-divided or well-rotted manure is infinitely superior. Corral scrapings, which are usually the first recourse when the idea of manuring springs up in a neighborhood, are not always well decomposed, but they are finely divided, and therefore decompose readily as compared with coarse straw, which, it is said, has been found practically unchanged even after lying two years in a dry, loose soil. It is, therefore, of the greatest advantage to prepare barn-yard manure with care for use in this State by some such method as will be described below, which includes composting, thereby turning to account nearly all organic material likely to be available:—

Clean up all the manure on hand just before the fall rains, putting the same on the land, and either cultivate it in or plow it under. What manure accumulates during the winter pile in a snug heap some five or six feet in depth, and throw it over some three or four times during the winter to keep it from burning, as well as to thoroughly mix it and thereby hasten decomposition. Put horse, cow, hog, chicken, and every other kind of manure that can be had, all together.

Never burn anything that will rot, but haul to the pile corn stalks, roots, and all squash, melon, tomato, and potato vines, etc., as well as weeds of every description, in fact, anything and everything that will decay and make vegetable matter. Use fresh horse manure mostly to hasten the decomposition of said vines, weeds, etc., alternating as the heap is made. By so doing there will not be a weed seed left with vitality enough to germinate.

It is well to have manure piles under a roof to avoid leaching during the longest and most excessive rains, but so situated that the rain falling on the barn can be easily conducted to the piles, giving them just the amount of water necessary and no more. Last summer I pumped, hauled, and put on a round manure pile, some twenty feet in diameter and six feet in depth, one hundred and ten large barrels of water before it began to moisten the ground around the base. Soon the dark liquid manure made its appearance on every side, but this I had anticipated, and had close at hand a plenty of dry sand and very fine dry scrapings from the cow yard to absorb it. I had

enough of this wet, fine material to completely cover the pile on every side as well as the top, then I covered that with very fine dry earth, which served to keep the pile from drying out during the long, hot summer, as well as to retain most of the ammonia, etc., that would otherwise have evaporated and escaped. I had only to apply a few barrels of water some months after directly on top, and late in the fall I found it entirely rotten, cutting like old cheese.*

TREATMENT OF MANURE WITHOUT COMPOSTING.—Even when composting all refuse vegetable matter with the manure is not thought worth the time and trouble, it is just as important to properly treat the manure when stored alone. This can be easily done by some such plan as is described below:—

For the handling of stable manure, I have found nothing better than placing it in a large bin and keeping it wet enough to prevent burning or "fire-fanging." I have tried composting and find that adds too much to the expense of hauling, besides the trouble of forming the compost heap. But with a bin, say ten or twelve feet square and five or six feet high, built convenient to the barn, the manure can be placed therein and watered daily with much less trouble than it can be composted with other material. This, of course, presupposes the ability to run the water in through a hose or by natural flow. Care must, of course, be taken that too much water be not supplied, causing the substance to be leached from the pile. But in my own experience I find the danger is at the other extreme, and when I open my pile I sometimes wish I had used more water. In filling the bin leave one end or side open as long as possible, for convenience of filling.†

Barn-yard manure and compost carefully prepared in some such way as described, and applied before the rains, to be turned under at the first plowing, will be in condition to be readily assimilated, and will not injure any soil.

SHEEP MANURE.—The proximity of the orange orchards of Southern California to extensive sheep ranges has led to large use of the manure from the sheep corrals, and so great has the demand become that the price of the material at Riverside has been quoted as high as $3.50 per ton. Sheep manure is usually counted richer and quicker, though not so lasting in its effects, as stable manure. In Riverside a good one-horse wagon load of sheep manure is usually divided between about a dozen trees of bearing age. In San Gabriel as high as twenty-five tons per acre has been applied to large orange and lemon trees.

Being highly nitrogenous, too free use of sheep manure tends to excessive growth of wood, especially on young trees. Old bearing trees may be benefited by such a stimulant.

VARIOUS WASTE PRODUCTS.

The care advised in saving and treating barn-yard manure, hen manure, bones, ashes, etc., should be extended to other waste products of the farm. Soapsuds should be allowed to run

*Ira W. Adams, Calistoga, in *Pacific Rural Press*, Aug. 17, 1886.
†B. C. Brown, Glenwood, *loc. cit.*

to adjacent trees unless used in the flower garden. Peelings and corings of fruit, cut for drying, should be fed to pigs and the resulting manure secured. It is not wise to corral the swine in a dry run in the summer and allow the manure to be sluiced out by the winter rise of the stream.

PRUNINGS.—Prunings of the orchard and vineyard should be burned between the rows, in small piles, so as to distribute the ashes well. It is not wise to carry all the prunings to the side of the highway and burn them there and allow the ashes to be lost.

Special treatment of vineyard prunings has come into quite wide use in this State, and different methods are employed. One is cutting up the pruned-off canes with an arrangement like a straw cutter, which reduces them to bits about an inch in length. They are then scattered over the surface of the ground, turned under at the next plowing, and soon decay. This is an important contribution toward perpetuating the fertility of the soil.

Where, through lightness of soil and short rainfall, the woody fiber does not readily decay, a method of burning, which well distributes the ashes, is widely practiced. An iron sled about ten feet long is used. At its front is a V-shaped iron rod, to which a horse can be hitched. On the sled are flaring sheet-iron sides and perforated bottom. This is filled with brush, a fire kindled, and as the horse moves forward fresh brush is added, while the ashes by its motion are sifted out very evenly all over the vineyard.

REFUSE FROM WINERIES.—Due attention should be paid to the utilization of waste products from the wineries. In many places we see the roads and avenues covered with the fermented husks, stems, and seeds, all containing the most valuable fertilizing properties, which, of course, go to waste. If, instead of spreading this refuse on roads and in holes, where it is of no account whatever, they would scatter it over the vineyard, much valuable substance would be returned to the soil. In some soils application of raw refuse would be undesirable because of the acidity developed. It is usually safe on calcareous soils, and for other soils should be composted with lime or wood ashes to facilitate decay and neutralization of the acid. Of winery refuse the lees are especially valuable because of the supplies of potash they contain.

OTHER WASTE PRODUCTS.—There are available from various manufactories different waste products which cannot be specified. When any such material comes to the notice of the

fruit grower, he should seek advice from the Agricultural Experiment Station, at Berkeley, as to the probable value of the material, and its special uses.

CAUTION IN USE OF FERTILIZERS.

Besides the injunction already given against application of fertilizers when the soil is already quite rich enough to produce good fruit and plenty of it, it should be noted that manures unduly rich in animal matter should be used with caution, as they may overstimulate the plant, delay or reduce fruiting, injure the quality of the fruit, and possibly engender disease in the tree or vine. At the East, where the peach is subject to the dread disease known as the "yellows," investigations covering a series of years lead to caution against "undue application of stable manures. If necessary to use them, have them well composted."* We do not have this disease of the peach in this State, but the caution will not be amiss, and the injunction to have stable manure well decomposed is a good one, for several reasons, as has already been shown.

The effect of undue use of stable manure, or other manures very rich in nitrogen, upon the vine has been frequently noted. Professor Foex† advises against such manure "on account of its too energetic action on vegetation, which causes the production of watery must, and wines wanting in solidity and flavor. Its influence does not last more than a year. These inconveniences may be palliated, and a more advantageous result be obtained, by mixing the fecal matter with vegetable débris (tan bark, sawdust, peat, seaweed, etc)." But the use of these coarse materials must certainly be avoided on light soils in California, for reasons previously stated.

METHODS OF APPLYING FERTILIZERS.

Suggestions concerning proper application of barn-yard manures, both to young trees at planting and to bearing trees and vines, have already been given. The same conditions which cause slow decomposition of stable manures apply to any fertilizing material which is not readily soluble in water. All such material should be in a finely divided state. Surface applications of ground bone will, in the dry climate of California, lie practically unchanged for a long period. Ground bone should be plowed in as deeply as can be done without injury to the roots of trees and vines, and then, if the surface is kept cultivated, it will lie in moist strata and decompose, or be seized by the

*Rep. of Professor Penhallow, Houghton Farm Experiment Station.
†First Annual Rep. Vit. Com., by C. A. Wetmore.

searching rootlets. On the other hand, superphosphate, or other really soluble chemical fertilizers, will produce immediate results, and can be most economically used on light and easily permeable soils, on which falling water sinks and does not flow over the surface. In leachy soils a part of such fertilizers might be carried down beyond the reach of shallow-rooting plants, but there is no danger of this in the case of trees and vines.

When superphosphate is used on irrigated ground, it is sometimes drilled in to prevent its being carried along with the running water. One way is to run a chisel-tooth cultivator ahead of the grain-seed drill and to distribute and drill in the fertilizer as deep as feasible to do without injuring the roots.

APPLICATION OF MANURES WITH IRRIGATION WATER.—A. B. Chapman, of San Gabriel, has for a number of years practiced the application of fertilizers by using the flow of irrigation water for its distribution. The method is described by A. S. Chapman, as follows:*

> On my father's place at San Gabriel we choose to manure lightly and often by shoveling sheep manure into the irrigating ditches, allowing each tree to receive about twenty-five pounds at each separate irrigation. Our basins cover the entire surface of the ground. We make no effort to choke such weeds as clover, alfilerilla, and the like; but the irrigator with his hoe destroys the obnoxious nightshade, hoarhound, and nettle.
>
> In the fall of the year we follow with a copious liming—about three barrels of unslacked lime to the acre—applied in the following manner at the head of our irrigating ditch: We plant a box about three feet wide, six feet long, two feet deep, and six inches under the surface of the running water. In it we place a barrel of the lime. It slacks and swells to twice its original bulk. A man stands on this with his hoe and sees that the water carries it off evenly. With an irrigating head such as we use, a man will run into the ditch four barrels a day, or about three barrels to the acre. We have a considerable fall, and the water runs very rapidly; but it takes up all the lime, and the water runs white, like milk.
>
> We now leave the orange orchard till spring, when we plow under weeds, manure and lime. We thus aim to supply our soil with nitrate of lime, potash, and magnesia. Carbonic acid gas is absorbed by the water and attacks the inert plant food in the soil; hardpan is prevented both by the mechanical effects of the vegetable matter and the lime.

The basin method of irrigation, to which allusion is made, will be more fully described in the following chapter.

GREEN-MANURING.

Mr. Chapman's practice also rests in part upon the value of green-manuring as secured by plowing under weeds and clovers, a policy commended in Chapter XIII, and frequently mentioned in Chapter III, as exceedingly desirable on some California soils. Green-manuring, aside from merely turning under natural

*Address at Riverside Convention, April, 1887.

rock or hardpan, while another similar soil, differently situated may receive abundant moisture from the drainage of the slope above it; fourth, possibly in all the soils cited there might be adequate moisture for deciduous fruits, but citrus fruits would require irrigation; or enough for young, but not for bearing trees.

Thus it appears that even to decide whether a location has sufficient rainfall for the growth of fruit without irrigation, one must pass judgment upon all the conditions first mentioned. It is hardly worth while, then, to discuss such a topic upon theoretical grounds, or to attempt to answer the general question, Shall irrigation be employed in the growth of fruit? The true guide is enlightened local experience, and the true test is the growth of the tree and the excellence of its fruit. So long as the grower secures a generous amount of good-sized and excellent fruit by natural rainfall, he need concern himself very little about irrigation; if his tree show distress, and his fruit, even when properly thinned out, is not up to the market standards every year, he may do well to provide himself with irrigation facilities, either for constant use or to supplement rainfall when it is occasionally deficient.

Of course it is not commended as a rule of practice that the grower wait until the tree shows signs of distress before applying water. This is a very bad plan of proceeding, but the visible language of the tree is mentioned as indicating once that the tree needs help, either at regular intervals or occasionally, and after such a warning the grower should be able to tell by examination of the soil and by study of the local rainfall record when this need will occur, and apply his water in advance of the need.

Whether irrigation facilities shall be provided in localities where natural water supply is usually adequate, but occasionally deficient, is largely a business question. Will the securing of such facilities cost less than the profit to be derived from a fruit crop uniformly large and marketable, or will the loss at long intervals be less than the cost of providing facilities. The question is analogous to that of insurance against loss by fire. Is it cheaper to pay insurance than to be occasionally burned out, or *vice versa?*

The fact that water is sometimes used to excess, and the fruit thus grown is found to be lacking in using and carrying qualities, militates not against irrigation, but against the ignorance or carelessness of the grower. It has been clearly shown* by the experience of our fruit shippers and canners that wisely-

*Interesting statements from leading canners and shippers may be found in *Pacific Rural Press* for Nov. 24, 1888, reprinted from Marysville *Appeal.*

irrigated trees bear fruit admirably suited to their purposes, and that if proper size is not attained with the natural rainfall, by proper cultivation, pruning, and thinning, irrigation should be resorted to. Of course the water should be applied at proper times, in proper amount, and in a proper way. An attempt will be made to aid the reader by suggestions on these points, but he must irrigate with his eyes open and his brain at work, for he will find plenty of local questions to determine by his own experience.

VARIOUS LOCAL PRACTICES.

The information which will best serve the public concerning the irrigation of fruit in this State will be a sketch of the prevailing local practices as to time and method of irrigation, with suggestions which may aid the irrigator in the development or distribution of water. To secure a sketch of local practices, the writer has compiled from original sources the following statement concerning irrigation practices in the different counties of the State:—

LOCAL PRACTICES IN IRRIGATION FOR FRUIT IN CALIFORNIA.*

Del Norte.....	Coast side.....	No irrigation.
Del Norte.....	East side, Happy Camp, Mountain Valley...	Irrigate all kinds of trees by running water near them for one day, two or three times during July and August.
Humboldt.....	.. ..	No irrigation.
Mendocino.....	.....	No irrigation.
Lake	.....	No irrigation on heavy, retentive soils. On light, sandy loam and on red mountain soils water is applied several times from June to August, as the trees seem to need it.
Napa.....	.....	No irrigation as a rule. In some cases, on gravelly soil in the upper part of the county, one good watering is given about the last of June.
Sonoma.....	....	No irrigation.
Contra Costa....	.....	No irrigation as a rule, but some growers use water on young trees, and on bearing trees when needed on non-retentive soils.
Alameda.....	. .....	No irrigation for orchard trees. Water is used on small fruits and figs in the lower part of the county.
Santa Clara.....	Alviso.....	With ordinary rainfall, no irrigation for orchard trees. In dry years a light irrigation is given in April or May.
Santa Clara.....	Santa Clara.....	Irrigate small fruits of all kinds, and sometimes orchard trees.

*The arrangement by counties in this statement is the same that will be followed hereafter in description of adaptation of fruit varieties, because it brings counties of similar climatic conditions as nearly as possible together.

Santa Clara.....	San Jose.....	Some growers practice winter irrigation; others on certain soils irrigate moderately in summer.
San Mateo.....	.....	No irrigation, as a rule.
Santa Cruz.....	.....	No irrigation for orchard trees; small fruits in Pajaro Valley irrigated about twice a month during summer.
San Benito.....	.....	Irrigation seldom, if ever, for orchard trees.
Monterey.....	Carmel Valley..	Irrigate cherries when fruit is setting, and when it is swelling, or it is apt to drop off.
San Luis Obispo	.....	No irrigation on coast side of the county, except for small fruits and citrus fruits.
Santa Barbara ..	.....	No irrigation for deciduous trees.
Ventura.....	.....	Dry mountain lands back from the coast, apples, plums, and pears are irrigated once, in June; peaches on sandy soil irrigated once every six weeks after April. On deep valley land no irrigation.
Los Angeles.....	Pasadena.....	Twice a year—June and August.
Los Angeles....	Westminster....	Orchard trees are irrigated the first year, and sometimes the second; once a year, in June, is sufficient.
Los Angeles....	Compton.....	Formerly it was the practice to irrigate deciduous trees twice a year, but has been found unnecessary.
Los Angeles....	Pomona.....	On mesas usually irrigate after May 1, from three to six weeks between irrigations, according to the age of the trees. Some growers do not irrigate deciduous fruit trees.
San Diego.....	San Diego.....	Some trees are irrigated twice a year; some not at all. The peach does better without irrigation unless the season is very dry.
San Diego.....	El Cajon.....	Citrus trees are irrigated two or three times in a season, and deciduous trees once.
San Diego.....	National Ranch.	Some trees are irrigated, others not, according to evident requirements.
San Diego.....	San Jacinto	General irrigation wherever water can be had, but deciduous fruits have been grown well without irrigation.
San Bernardino..	Riverside.....	All fruit trees are irrigated from three to five times during the season, from May to October. In a dry season a good irrigation is given in winter or spring.
San Bernardino..	San Bernardino.	About once a month during the summer months.
San Bernardino..	Redlands	Peach, apricot, and orange, irrigated about six times during the year. Another grower begins the first of June, and irrigates once a month until October.
San Bernardino..	Old San Be'dino	Irrigate every thirty days, from May, until the fruit is gathered.
Kern.....	Bakersfield.....	Frequency of irrigation depends upon character of soil. Water is given as the trees seem to need it.
Tulare	Farmersville. ..	Practice varies considerably. Some give one good winter irrigation in February; others irrigate once in the spring; others give two irrigations, one in the winter and one in the spring; others two or three times from May to August. Young orchard is irrigated more frequently, as a rule.

Fresno.....	.....	Early practice was to irrigate frequently, as often as once in two weeks. Since the soil has become saturated, and water-level has risen, some trees are not irrigated at all; others once or twice during the year.
Merced.....	Merced.....	Once a month during the summer.
Merced.....	Snelling.....	On light, sandy loam frequent irrigation is given; retentive soils less frequently; decision is made by examination of the soil and the trees.
Stanislaus.....	Modesto.....	Five or six times between April and October.
Stanislaus.....	Turlock	Trees should be watered frequently in summer, unless mulching is practiced, which proves a good substitute for irrigation.
San Joaquin....	Stockton.....	On loamy soils frequent irrigation is given during the summer, but much fruit is grown without irrigation.
San Joaquin...	Islands.....	No irrigation generally.
Sacramento....	Cosumnes.....	In dry years an irrigation is given in June.
Sacramento.....	Brighton.....	Practice varies. Some growers irrigate only small fruits; others give two or more irrigations during the summer, while the fruit is growing and ripening; seems to be especially desirable for late fruit.
Solano	.....	No irrigation.
Yolo.....	Washington	No irrigation.
Yolo.... . ..	Davisville.....	Irrigate during May, June, and July.
Yolo.....	Woodland.....	Irrigation of raisin grapes usually stops in June; sometimes vineyards not irrigated.
Yuba	Marysville.....	No irrigation, except for citrus fruits.
Yuba..... ...	Camptonville....	Red Mountain soil; irrigate liberally twice a month, from June to September.
Sutter.....	....	No irrigation, except citrus fruits.
Butte.....	Chico.....	No irrigation for deciduous fruits.
Butte.....	Oroville.	Deciduous fruits irrigated or not, according to situation and soil; citrus fruits irrigated for four months.
Colusa.....	....	On low lands some growers give a good flooding in winter, and then trust to thorough cultivation.
Colusa.....	Orland.....	Gravelly loam plains, winter irrigation suffices, except for small fruits.
Tehama.....	Red Bluff.....	Some growers irrigate the first year, and not afterwards.
Shasta.....	Redding..... .	Irrigation during June, July, and August seems an advantage.
Shasta.....	Shingletown....	Red mountain soil; irrigate young trees twice a month, from June to September; old trees less frequently.
Shasta..... ..	Ball's Ferry ...	Moist river bottom; no irrigation.
Shasta	Anderson.. ...	Deep valley land; no irrigation.
Siskiyou	Scott Bar	Loose, loamy, or sandy soil; irrigate once a week.
Siskiyou.....	Fort Jones.....	Gravelly loam; irrigate once in three weeks during summer.
Siskiyou.....	Henly.....	Sandy loam; irrigate once a week, as a rule.
Plumas.....	.....	Irrigate about once a month during summer.
Nevada..... ..	Nevada City....	Twice a month during June and July, and sometimes in August; some claim irrigation unnecessary.

Placer.	Practice varies as to frequency, from once a week during the summer, once in two weeks, or once a month; frequent application most prevalent.
El Dorado.....	Once a week or ten days, from June to September, is usual. Some growers irrigate once every two or three weeks. Some report plums and prunes doing well without irrigation, and fruits generally for drying can be grown without water.
Amador.....	Flat land, once in three or four weeks; hillside, once in two weeks. Others irrigate bearing trees once in two weeks; young trees, every week; others, on black alluvial valley land, do not irrigate; some hillside vineyards not irrigated.
Tuolumne.....	Practice varies greatly, according to soil and exposure, and intensity of heat; twice a week, once a week, once in ten days, once a month from May until October.
Inyo.....	On sage-brush land, once or twice during the summer, and thoroughly when the late fruit is ripening.

The foregoing sketch of irrigation methods is not put forth as a guide to local practice, nor as a statement of the best methods for the localities named. It is merely an outline of existing policies and methods, which are, no doubt, in many cases susceptible of improvement. The notes are from reports of practical operators in the localities named, and in most cases are merely accounts of individual methods, and not generalizations, even for the localities themselves. The difference in soil and subsoil, even on adjacent tracts, makes it possible for one grower to reduce or dispense with irrigation by resorting to frequent cultivation, while a neighbor cannot successfully do so. For this reason, definite instructions cannot be given, as has been pointed out in the opening of this chapter. And yet the attempt to outline general practices is of interest, and the writer would be gratified for any corrections and additions which the reader will supply as the result of his observation or experience.

METHODS OF IRRIGATION.

There are various methods employed in California for the conveyance and application of water to trees and vines. Some of the principal ones may be enumerated and described, as follows:—

PERMANENT DITCHES.—Permanent runways for water are becoming far less popular than they were in earlier days, because it is seen that the trees thrive far better if cultivated. There is, however, on hill lands difficult to plow and cultivate, and prone to wash, a naturally strong temptation to lay out the

ditches once for all on grades suitable for slow running of the water, and trust to seepage and percolation from these ditches to supply moisture to the trees adjacent to them. By this method irrigation must be more frequent than by other methods which will be described, because the soil is not so well saturated, and even the more frequent application takes less water than less frequent application through newly-turned furrows. There is, also, necessity for much work with the hoe if the grower pretends to keep down the weeds—which, however, is not always done, and the running water distributes the seeds.

FRESH FURROWS.—Irrigation by freshly-turned furrows is the most prevalent method in this State, and is popular in all our irrigated regions where the soil is such that water freely distributes itself laterally, and does not flow directly downward, as in some soils. The furrow system, as practiced at Riverside, will serve to illustrate the method. The private distributing ditches are usually paved with rock or faced with lumber, and run along the highest ground in the orchard. As the ditch passes each row of trees, a board is inserted in the side, as many auger holes are bored as will let out water enough to flow to the end of the row in ten or twelve hours. Application to the furrows for trees of different ages is described by the late James Bettner, as follows:*

The young orange orchard planted in March should be irrigated fortnightly for three irrigations, subsequently once a month during the first season. It will be sufficient for the first year to run one furrow each side of the trees, close to them, and allow a small stream to run by for ten or twelve hours at each watering.

The second season less irrigation will be needed. The same number of furrows will answer, and it will be sufficient to water once every six weeks, or even two months.

For the third year about the same amount of water will be used as for the second. Beyond this as the trees increase in size it will be found necessary to gradually increase the number of furrows between the rows until, eventually, when the trees attain the age of ten or twelve years and are producing good crops, your furrows should be run through the whole space at intervals of about three feet. The water should be run longer after the first season, from two to twenty-four hours, according to the nature of your soil as to porousness, *after it has reached the end of each row.* The amount of water needed for trees twelve years of age, in good bearing, will not be less than three times the quantity required by the same trees during their second and third years in the orchard.

The Placer County method of irrigating by fresh furrows is described by P. W. Butler, as follows:†

By the new method it is not necessary to apply water twice a week (as by the old permanent ditch plan), for quite as good or better results can be attained by irrigating once in two weeks by plowing a furrow on each side of the tree in young orchards, and filling them with water, throwing in dirt with a shovel where the grade is steep,

*Paper at Fruit Growers' Convention of 1886.
†*Pacific Rural Press*, Nov. 15, 1884.

so that the water may stand in the furrows. As soon as the furrows are full, shut off the water and allow it to flow into other furrows. The next day, or when the soil is sufficiently dry, run over the furrow with a cultivator not less than three feet wide.

If the trees are large, plow furrows four to six feet apart, fill them as before, and afterwards cultivate crosswise of the furrows. At each subsequent irrigation run the furrows in a different place, that the water may be equally distributed through the soil.

Weeds cannot grow to do injury by this method of irrigation; the moisture is conserved, and the soil constantly kept loose and aerated. With one horse and a single shovel plow, or a sidehill plow on steeper grades, one man can prepare ten acres for irrigation in a day, at a cost of $2.50. With two horses and a cultivator six feet wide, one man can cultivate the same ten acres in a day, at a cost of $3.50. This would make the working of ten acres cost $6.00, or a total of $6.00 per acre for a season of ten irrigations. The cost of tending the water will be little or no more than by the old plan of permanent runways. The stream being larger, it covers the ground in less time, and need not run after the furrow is filled.

It will be noticed that the two furrow methods described differ. In Riverside the water is allowed to run slowly for a certain specified time in the furrow without overflowing—counting from the time that the water reaches the end farthest from the distributing ditch. In Placer County the water is taken from the furrow as soon as it is once filled by a large flow.

FLOODING, CHECKS, AND BASINS.—These are different methods of bringing the water to bear upon a broad expanse of surface, and are best fitted for deep, leachy soils, in which, from the direct downward course of the water, the distribution by furrows would be very imperfect.

Flooding, as the term implies, consists in allowing the water to flow over the whole surface of the ground, dirt being, however, drawn up around the tree to prevent access of water to the bark, which is a cause of serious disease. Flooding is done by running a considerable head of water broadcast down each several row, shifting it from one to another as soon as the stream has run through. To use this method the ground must be quite level, or serious washing is likely to ensue, and the soil must be of rather a porous character, for the water is not held in contact with the soil, as in other methods. Arrangements for flooding are sometimes made as follows:*

After an orchard is fully established, say five or six years after planting, it is found best to use a two-horse plow, turning a furrow away from the trees, and on both sides of the row, at least four feet from the trunk. This leaves a strip eight feet wide between the furrows. The water is turned into these spaces and spread evenly over the ground, flooding this strip thoroughly. Then, when the soil is in proper condition, this space is cultivated thoroughly and leveled with a horse hoe, cultivator, or other implement. The length of time that should elapse after irrigating and before cultivating depends mainly on the nature of the soil. I have found this to be an excellent plan where water is plenty; but where it cannot be had in sufficient quantities, other and more economical methods must be resorted to.

*"Garey's Orange Culture, p. 47.

Checks or basins are employed to restrain the water upon a broad area of soil around the tree. They consist of an enlargement of the generally-practiced method of irrigating garden shrubs and young trees by making a shallow excavation around the tree with a hoe (leaving some soil adjacent to the trunk), and running the water into this receptacle as long as thought necessary. When the restraining sides are made by throwing up back furrows with the plow, the inclosed space is usually called a "check," from its resemblance to the checks made by levees on contour lines on large irrigated fields; when the excavation is made circular in form, and in size agreeing with the diameter of the tree (which is the rule adopted), it is called a basin. The "checks" are connected by a furrow down which is run the water to fill them. Begin with the lowest "check;" close the furrow leading into it. The "check" next above will then fill, and so on to the top of the row. This method is a good one, as it economizes water, and completely saves all fertilizing matter the water may contain. It involves, however, considerable hand labor, though a good part of the work of making the "checks" can be done with the plow.*

The basin method is largely employed by A. B. Chapman and others in the San Gabriel Valley. Every tree has its basin, and they are filled from the ditch which flows down between each pair of rows. When the basins are full, the water stands from six to twelve inches deep in them. Mr. Chapman says he could not irrigate by running the water in a furrow. That would require less water, but a sufficient flow of water would wash his soil away, and a small stream would sink into the ground as into a sieve. Therefore it becomes necessary to irrigate with a large head of water. The use of basins prevents summer cultivation, as they are made but once a year. Mr. Chapman's preference for such practice has already been described in the chapter on "fertilizers."

Sometimes these basins are worked with a spading fork to prevent evaporation. Others fill the basin with rotten straw for a mulch, to accomplish the same ends, but to this it is objected that gophers are harbored unless water is frequently applied to destroy them. Where the trees are large, and the drooping branches shade the ground well, the basins are undisturbed until the fall plowing.

DEVELOPMENT, STORAGE, AND DISTRIBUTION OF WATER.

It is, obviously, beyond the limitations of this work to attempt an extended review of irrigation enterprises and practices.

*James Bettner, *loc. cit.*

The enterprises undertaken by capitalists, or by co-operation among settlers, require the services of competent engineers. What these enterprises are, in the southern part of the State, where most irrigation is practiced, how they have developed and stored water supplies, constructed reservoirs, ditches, pipe lines, etc., is fully described in a volume which has just been published by the State.* The same service is contemplated for other parts of the State in which irrigation prevails, and California irrigation practices are also to be described in a future publication. All these matters are too great in extent and variety to be discussed in this work. As, however, it has been the aim of the writer to aid the inexperienced planter to help himself in small efforts, a little space will be given to suggestions as to how a planter may develop and use such small water supply as may be derived from spring or small creek on his own land without employing an engineer.

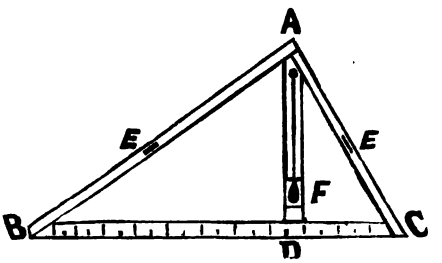
RUNNING LINES FOR IRRIGATING DITCHES.—How far to go up a creek in order to bring water out upon a given piece of land is a question which frequently arises in individual practice. There is also doubt as to how much fall should be given to the ditch. The fall required by a ditch or canal depends upon the amount of water which it is desired that it should discharge, and upon the width and depth with which it is intended that the water should flow. It may also be dependent upon the character of the soil in which the ditch is to be constructed, and upon the peculiarities of the water itself. A strong current in soft soil may cause mischievous erosions. Water carrying much sediment must never be allowed to move sluggishly, as clear water sometimes may. It is best to state the requirements to a competent engineer and act on his suggestion, or secure the counsel of a neighbor who has had experience with similar soil and water.

Having decided what fall to give the ditch, the nearest point at which water can be taken out of a creek to be brought to a certain piece of land is found by commencing with the point at which the water is to be delivered (generally the highest point of the land to be irrigated), and running a line up stream which has the inclination intended for the ditch.

To stake out this line when no special hindrances are in the way, use a home-made leveling instrument constructed as follows:—

*"Irrigation in California (Southern); the Field Water Supply and Works; Organization and Operation in San Diego, San Bernardino, and Los Angeles Counties," by Wm. Ham. Hall, C. E., State Engineer. For sale by the Secretary of State, Sacramento.

With such lumber as may be at hand, a triangle is made, as indicated in the sketch. The three pieces, *A B*, *B C*, and *C A*, are made fast to each other at *A*, *B*, and *C*. The board, *A D*, is fastened to the triangle at right angles to *B C*. Near *A*, on the board, *A D*, a plumb-line is made fast. The plumb, like a mason's plumb, hangs in a hole at *F*, so that when *A B* is vertical, the string hangs very near the surface of the board, *A D*.



A HOME-MADE LEVELING INSTRUMENT.

It will be seen that when *A D* is exactly vertical, *B C* is exactly horizontal, if the angles at *D* are true right angles. An ordinary carpenter's square used in the construction of the apparatus will insure sufficient accuracy in the position of *A D*.

In marking on the board, *A D*, however, the line in which the string of the plumb will hang when *B C* is exactly horizontal, more care is required. Two pegs are driven, as far apart as *B* and *C*, for these points to rest on. The highest one is driven into the ground until the plumb-line follows about the center line of the board, *A D*. Having marked this position of the plumb-line, the triangle is reversed so that the end *B* rests on the peg where before we had the end *C*, and *vice versa*. Should the plumb-line be in a position at variance with the first one marked on the board, then the correct position for the *B C* horizontal will be exactly in the middle between the two found by the aid of the two pegs.

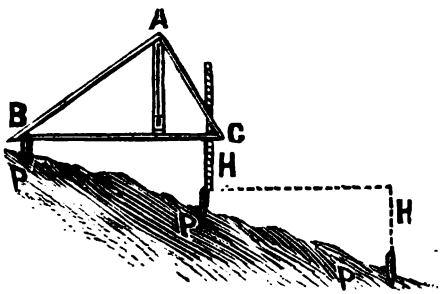
It will frequently be found convenient to have a scale of feet marked off on *B C*. The dimensions of the triangle may be about as follows: *B C*, 12 feet long; *A D*, 5 or 6 feet., and *C D*, 3 or 4 feet. Holes in the pieces *A B* and *C A* at *E E*, or handles, will make the triangle convenient to carry. Only two men are necessary in using it.

To use this instrument for locating the line of the ditch, calculate the amount which your line should rise between each two pegs. Drive a peg at the starting-point with its top say six inches from the general surface of the ground. Hold one end of the leveling apparatus above this peg by exactly that amount which the line rises per each instrument length (*B C*), and swing the other end around into the direction from which the ditch is to come, until, when level, it is just six inches above the ground. Drive a peg here, which will, like the first, be six inches high, and proceed as before. Care should be taken to give the top of each peg exactly the correct elevation. The level must be horizontal when resting on any peg, and raised exactly that amount which the line rises per level length, above the preceding peg. It will be found convenient to use a carefully-prepared block to hold on the top of each stake at the rear end of the level instead of trusting to measurement each time.*

LOCATING CONTOUR LINES FOR CHECKS OR FOR DISTRIBUTING DITCHES.—This work can be done with the aid of

*C. E. Grunsky, C. E., in *Pacific Rural Press.*

the level above described. For instance, to locate a contour (a line of equal elevation), as required in the construction of a check levee, drive a peg until its top has a convenient elevation from the ground, say one foot. Rest one end of the triangle on this peg and swing the other around until when *B C* is horizontal this other end has exactly the same elevation from the ground as the top of the peg. At this point drive a second peg and proceed as before. If the tops of the pegs be chosen at the height of the levee, they may be retained as grade stakes as well as line stakes for the embankment.



LOCATING CONTOUR LINES.

To find some point of the check levee, next below one already located, or below the highest point of a field, begin as indicated in the cut, where *P* represents the starting-point. Below *C* drive a peg, *P'*; raise or lower *C* until *B C* is horizontal; measure with some convenient scale the height (*h'*) of *C* above *P'*, and make a note of the same. Repeat this operation between *P'* and *P''*, and continue until all the heights, *h' h''*, etc., added together are equivalent to the height of the starting-point above the base of the next check levee below it (generally the height of each embankment). The last peg should be, of course, a peg with its top at the surface of the ground.

STORING WATER FROM SMALL SOURCES.—For individual uses quite a respectable water supply can sometimes be developed from apparently mean sources. This can be done by clearing out and opening up hillside springs, and often by tunneling into the hillside to intercept subterranean water-flows. This is done on a grand scale by water companies, but it is also practicable in a small way. Small supplies of water are, however, always turned to best account by providing for accumulation and storage of the slowly-gathering water. Mr. H. J. Rudisill, a prominent citizen of Riverside, has pointed out that even a small spring, yielding but two quarts per second, is equivalent to a three-inch stream, and would be sufficient for twelve to fifteen acres in fruit trees, and with sub-irrigation a much greater area. To derive the greatest benefit from small springs, however, a reservoir is necessary, in which the flow of twelve to twenty-four

hours, or even a longer period, can be accumulated, and then discharged as required. It is by using water in driblets that many springs are wasted. A spring supplying even one and a half inches of water would be wholly swallowed up by a thirsty soil within two hundred feet of its source, when, by arresting the flow and accumulating it in a reservoir and discharging at intervals in a volume four times as large, it would more than cover eight times the surface. A spring flowing two quarts per second will discharge forty-three thousand two hundred gallons in twenty-four hours. This would require a reservoir forty by twenty feet, and seven feet deep, or double that width if the depth is decreased one-half. The shallower it can be made the better, for many reasons, but especially on account of the temperature of the water. That of springs is generally too low in summer for immediate use, and its value is greatly enhanced by being raised to an equal or greater temperature than that of the air. This is quickly done by exposure in a shallow pond.

A reservoir can be constructed entirely in the ground where the slope will admit of it, and by lining the bottom and sides with clay well puddled, will answer for most purposes. At San Bernardino some are built of adobe, backed with earth and plastered on the inner side with hydraulic cement. Concrete of lime, sand, and broken stone is, however, the best material, where lime can be readily obtained, and any person with ordinary mechanical genius can construct them. When the reservoir is shallow, and consequently there is but little pressure, the lime will be sufficient to make it water-tight. The limes of Southern California are slightly hydraulic in character, making excellent dams, reservoirs, and aqueducts, as the works left by the Mission Fathers fully prove.

Where there are a number of springs of small volume, they can easily be gathered into one conduit or reservoir by a system of underdrains, very cheaply made with broken stone. A grade of six inches to one hundred feet will not wash in ordinary earth, and will be sufficient fall to keep the drain free from sediment. When a greater fall than this is required, the drain could be paved with stone, leaving an opening sufficient to conduct the water freely. Or a cheap continuous concrete pipe of sand, lime, and a small portion of cement, can be made in the trench or upon the surface of the ground by using a center-piece of wood turned to the diameter of pipe required, and as fast as the mortar sets around it the center can be withdrawn. Wooden pipe of two to four inches diameter is cheaply made in the Eastern States from young, thrifty timber, bored with the old-

fashioned pump auger. When the pipe is required to withstand considerable pressure, it can be greatly strengthened by bands, or wrapped with light hoop iron. The young pines and white cedar of the mountains would be excellent timber for this purpose.*

LOSS OF WATER BY SEEPAGE.—The great loss of water by seepage during a long run has led to the cementing of ditches, and to the use of miles of large concrete and iron pipe by the irrigation companies of Southern California; also, where the slope is rapid, paving ditches with rock has been resorted to. Similar efforts naturally suggest themselves to the user of a small water supply to save his flow from loss. Where lumber is cheap, the use of a board flume is the best means of saving water, though it is at best rather expensive, and has to be patched and renewed.

DEVICES FOR TAKING WATER FROM DITCHES.—Water is, of course, easily taken from flumes by auger holes at proper intervals. Special devices are employed to divert water from ditches. There is largely used in Southern California what is called a "tappoon." Tappoons are made of heavy sheet iron, and of a semicircular shape, with the top or diameter of the circle securely fastened to a cross-piece of scantling two by three or more. They are made of different sizes, to correspond to the width and depth of the zanja or water ditch in which they are to be used. In using them they are placed crosswise in the ditch at or near the point where it is desirable to direct the water upon the land to be irrigated, and they instantly dam and divert the stream through a lateral opening. They are also useful in closing the holes in "checks," so the water will not run through.

DEVICE FOR TAKING WATER FROM A DITCH.

An arrangement for readily tapping a ditch is that shown in the accompanying sketch, which is used in the foot-hills. Its construction and use are described as follows:—

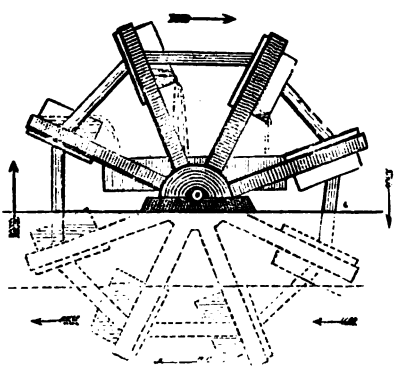
*H. J. Rudisill, in *Riverside Press.*

Cut six-inch boards into fourteen-inch lengths, and sharpen one end and bore two holes, as shown in the sketch. Cut the ditch bank and drive a board at each place where you want water turned out. Regulate the supply by driving down the boards, and shut off the water by plugging one or both holes with grass or mud. By always using the same quantity of water, once regulating the depth of the boards will last a season.

The trouble is the holes plug up with trash, but that trouble applies to all ways of spreading water, and the trash is good for the land. By cutting out the boards on the dotted lines, they do not choke so badly. Drive the boards well to the inside of the ditch, or you leave a niche for mud to eddy into. On well-sodded ground the roots soon close around the boards so that they may be pulled out when much water is wanted, and put back again.

I bore inch holes an inch apart in the clear, and the upper one four inches from the top. It pays me to occasionally put on gum-boots and paddle through the ditch and slum out the leaves and sticks.*

LIFTING WATER FROM FLOWING DITCH OR STREAM.—Where a stream has a rapidity of two miles or more per hour, and a lift to a height of six to sixteen feet will give head enough to distribute the water over a considerable area, there is nothing cheaper than the current wheel which is largely used in this State. The engraving gives an end view of such a wheel. Eight pairs of arms, carrying plain flat buckets like those of a steamboat paddle-wheel, extend from a hub rotating on metal bearings. At either end or both ends of each bucket are fixed water boxes which fill themselves on entering the water, and on being brought to the highest point of rotation empty themselves into a receiving trough. This trough supplies the distributing ditches, etc., and its inner end is so placed that it comes under the projecting buckets of the wheel without interference with the motion of the arms. The current of water in the channel underneath forces the buckets down stream, the latter delivering in the opposite direction at the top. By using a double set of buckets, one at each end of each bucket, the water may be delivered on both sides simultaneously. A little experimenting will indicate the proper size of the boxes, which depends upon the velocity and volume of water in the channel as well as the amount to be delivered. Such a wheel can be readily constructed by any me-



END VIEW OF IRRIGATING WHEEL.

*S. W. Shafer, in *Pacific Rural Press.*

chanic, and will cost from $25 to $50, according to size and workmanship. It may be made altogether of wood, with the exception of the bearings, but for the larger sizes (of from eight feet to fifteen feet or upward) it is advisable to brace well with wrought-iron tie rods. The water boxes may be made of wood, but tin is serviceable—the size chosen to be in direct ratio with the force of the current. It is not usual to paint the wheels unless iron enters largely into the construction, in which case red lead may be used.*

At the Fancher Creek Nursery, in Fresno County, a wheel is used eighteen feet in diameter, and carries sixteen buckets, which empty into a trough sixteen feet above the ditch. The wheel lifts about one cubic foot in two seconds.

THE MINERS' INCH.—Irrigation borrows its water measurement from the miners, and horticulture in the foot-hills has fallen heir to many old ditches constructed by the miners. The "miners' inch" is the general standard of water measurement in this State. There is a slight difference in the miners' inch in some of the different mining districts. In some districts it is the amount of water discharged from an opening one inch square through a two-inch plank with a pressure of six inches above the opening. In other districts there is less, and in others more, depth above the aperture, etc. There is, however, a miners' inch, as described by section 1415 of the Civil Code; which specifies a miners' inch in this State as that quantity of water which will flow through an opening of one square inch in the bottom or side of a vessel, under a pressure of four inches above the opening. Fifty of these miners' inches are equal to a discharge of one cubic foot of water per second, and is less by .312 of a cubic foot than the Nevada County miners' inch. The generally-accepted inch of water is that which is equal to seventeen thousand gallons of water every twenty-four hours, or about one hundred pounds per minute; and this amount will flow through every square inch of opening in a gauge under a pressure of six inches above the center of the opening.

DUTY OF WATER.—What amount of water will serve for any specified area of ground depends so completely upon the character of the soil and subsoil, the percentage of atmospheric humidity, the crop to be grown, etc., etc., that no general rule can be given. The inexperienced person must inform himself by inquiring among his experienced neighbors as to local requirements. It may be stated, however, that the extreme service

*Albert Williams, Jr., in *Pacific Rural Press.*

claimed for water is from eight to ten acres of trees or vines and five to six acres of small fruits per miners' inch—meaning the amount of one inch running constantly, but to be handled in multiplied inches applied at intervals.

RANDOM SUGGESTIONS.

Without attempting an impossible thing, to wit, to furnish explicit directions for the practice of irrigation, for much of it every man must learn for himself by experience, a few suggestions may be noted, even though more important ones do not come to mind:—

Usually water should be prevented from actual contact with the trunk of the tree. Citrus trees are especially sensitive to such contact, and resent it by "gum disease," which was formerly far more prevalent in the State than now. Care must, therefore, be taken not to set trees which are to be irrigated, too low. It is better to raise them up a little and draw the earth up around them to prevent approach of the water.

If possible the ditch should run on the shady side of the tree, because reflected sunshine from the water surface may burn the bark.

In examining soil to ascertain dryness, one must dig deeply, for often an upper layer will be fairly moist, if well cultivated, while lower layers, where the feeding rootlets are, will be arid. Therefore, when trees or vines are suffering, dig far down in examining the soil.

In irrigating, thorough, deep soaking is necessary, and examination must be made to see if an artificial hardpan which prevents the descent of the water has been formed.

In distributing water on hillsides, ditches must, of course, follow serpentine courses, according to contour lines, to give the water a slow flow, which is conducive to seepage. These same ditches will in winter conduct the storm water slowly to the bottom of the slope and prevent washing.

Be careful not to continue irrigation too late in the season. It will prevent the proper dormancy of deciduous trees, and if more fall irrigation is given citrus trees than they need for perfecting the fruit, the trees will continue growing tender shoots until they are injured by severe frosts. On the other hand, it is sometimes advisable to give deciduous trees a draft of water after the fruit has been gathered, if the soil is so dry that the tree is likely to drop its leaves too soon, and wake from its dormancy with the first rains. Many times the fall blooming of deciduous trees, which is very undesirable, may be prevented by

keeping them growing later in the summer by moderate irrigation.

Many times a reservoir can be cheaply made by hollowing out a basin on the top of a knoll, making the sides rather flat, and finishing with cement directly on the hard earth. To such a reservoir water can be pumped, and afterwards easily distributed to lower grounds by gravitation.

Cold water is not desirable for irrigation, as has been remarked in connection with the building of small reservoirs. Winter irrigation with cold water has, however, been employed to prevent trees from coming out too soon in a mild winter.

If trees or vines, in regions usually irrigated, are to be grown without irrigation, it is important that the grower be more than usually thorough and constant with his summer cultivation. In trying the non-irrigation experiment, one should, of course, begin with young trees which have not been irrigated, and not usually expect success by withdrawing the water from trees which have been accustomed to it, and have developed a root system accordingly.

SUB-IRRIGATION IN CALIFORNIA.

The application of water to the soil by subterranean conduits was suggested many years ago, and practiced to a limited extent. In the early days iron troughs inverted upon redwood boards, small flumes or boxes of redwood, bricks set on edge and covered with redwood boards, drain tiles, etc., were suggested, but no such device came into active use. The idea in all these devices was to bring the water to the roots of the plants, thus saving water by preventing evaporation, reducing cost of cultivation, and preventing growth of weeds by preserving the top layer of the soil dry. The expense of all such arrangements, for material and for cost of excavating and placing these conductors two feet under-ground, was a bar against the introduction of the system, and the filling of the conductors with thirsty roots seeking moisture, showed that it would be necessary to take up and clear out the pipes at intervals, thus increasing the expense bill. A few years ago a system of sub-irrigation was devised by E. M. Hamilton, of Los Angeles, which was vastly superior to any previously suggested, in that it consisted in laying a continuous cement pipe by a machine operating in the trench, thus leaving no crevices for the entrance of roots, and in providing exits for the water also guarded from the approach of roots. Elaborate illustrated descriptions of the system were published, and perhaps a few hundred acres were piped by this system. The cost of introducing the pipes and providing suit-

able reservoirs was greater than anticipated, and, in some cases, the pipe, being too poor in cement, did not endure. For these, and, perhaps, other causes, the system has not secured wide use in this State. Theoretically, it seemed the perfection of direct and economical distribution of water, and there is still wide inquiry as to the reasons for its apparent decadence, which has not yet been fully explained.

Though the irrigation of single trees is usually done by hoeing excavations around them, into which water is poured, and fine, dry soil hoed over the moistened surface afterward, it may be that some reader growing a few trees in his garden may think it worth while to prepare for sub-irrigation by the following effective, but rather troublesome, way: At the time the tree is planted, at the bottom of the hole put a layer of sand one inch deep; in this sand set an empty tin cylinder, two or three inches in diameter, open at both ends, and long enough to reach above the surface of the ground; over the sand spread another layer of soil suitable for the nourishment of the tree; upon this place the tree and fill in, as usual. Now fill the tin tube with gravel or coarse sand, gently poured in, so that when the tube is withdrawn the sand will drop through it and fill the hole. A tunnel shape may be given to the upper part of the gravel column, by working the tube around when it has been nearly withdrawn; and it is well to leave a trench around the rim of the excavation, that will hold two or three buckets of water. The water, nearly as fast as poured in, sinks down the gravel shaft and distributes itself among the roots of the tree. Some gardeners reach the same result by burying a drain tile, tin can, or something of the kind without a bottom, in the hole with the tree, allowing the top to be about flush with the surface of the ground, where some sort of a cover is used. When water is poured into the receptacle, it soon sinks away at the bottom. Such arrangements are only practicable in gardens where one is content to give much time to a few trees.

PUMPING WATER FOR IRRIGATION.—Hundreds of horse-power and steam pumps are used in this State for lifting water from wells and streams to irrigate both large and small areas. Information concerning cost and service performed is readily attainable from the manufacturers and dealers in this class of machinery.

IRRIGATION FROM FLOWING WELLS.—The number of artesian wells has multiplied rapidily during the last few years, and whole regions, like that east of Tulare Lake, are being

turned into orchards, vineyards, and gardens, by the flowing water, which is cheaply obtained by boring. The older artesian districts are the Anaheim district, of Los Angeles County, and the Alviso district, of Santa Clara County. Recent experience shows that artesian water can be had in many parts of the State, not only in the broad, low valleys, but in the mountain valleys high up in the Sierra Nevada.

WINTER IRRIGATION.

The practice of winter irrigation is growing in California, both in the "irrigated districts" and in districts in which reliance is usually placed on rainfall. In many soils it has been found that thorough soaking of the soil in winter, followed by thorough summer cultivation, will take the place of much summer irrigation, and in non-irrigating regions a good winter soaking artificially insures against occasional seasons of scant rainfall. But in all soils and situations, winter irrigation will not suffice, just as in some soils an average rainfall of, say forty inches, will not carry the trees through the summer, though in other soils half that amount may make irrigation unnecessary.

In all soils, however, which under good cultivation are fairly retentive, winter irrigation, when water is most abundant, and usually carries most sediment, can be made to go far toward making summer irrigation unnecessary for all deciduous fruits, including, of course, the grape, which is, perhaps, most prospered by the practice which has been adopted in a number of large vineyards in different parts of the State.

As to winter irrigation, practice varies, some relying upon a single heavy flooding by using checks on contour lines, by which, perhaps, a foot in depth or more of water is allowed to soak into the soil; others use the same method of application in winter as in summer, and, therefore, give a number of irrigations in winter. There is, of course, much less danger of injury by water to deciduous growths in winter, because they are dormant, though an eye should be kept on drainage for excessive irrigation as for excessive rainfall. The grape and the pear are known to endure long submergence, but some other fruits are sensitive about it.

DRAINAGE.

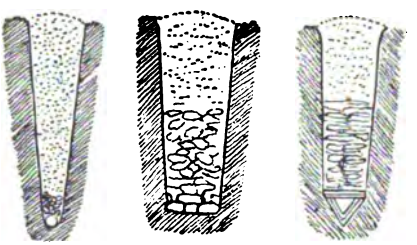
So many allusions have been already made to the subject of proper drainage of fruit lands, and so many more will, probably, follow, that it will not be necessary to make a long special plea for its importance. It may be said, however, that in regard to drainage, as to fertilization, which has been cited, there has been

for a long time a very erroneous popular generalization that California soils do not need drainage; that in a dry State the aim should be to retain moisture, not to part with it. It is, of course, true that we have vast areas of naturally well-drained soil, upon which any money spent for drainage would be in great part thrown away, but we have, also, both in the valley and on the hillsides, localities where, by peculiar character and conformation of the subsoil, water is held in the soil until evaporated from the surface, and the result is a boggy, miry condition, which prevents proper winter cultivation, and at the same time injures the roots of the trees or vines. This defective cultivation, added to the puddling effect of standing water, makes the soil dry out completely under the fervid sun of summer, and the result is that the wettest soil of the winter is the driest in the summer, and plants which are injured by soaking in winter suffer again from lack of moisture and sustenance in summer. Thus it is a fact, clearly proven by observation and experience, that thorough under drainage removes surplus moisture in winter, and ministers to the retention of moisture in summer. More than this, a soil puddled by standing water cannot present its contents in available form for plant nutrition, and besides it loses the fertilizing effects of atmospheric currents, which freely pass through an open, well-drained soil. Wet land is cold and late in spring, and hot as a baked brick under the summer sun; it is no fiction of the imagination to say that well-drained land is warm in winter and cool in summer—that is, cool to a degree which favors quick and free root growth, and cool enough to escape the parching effect of deeply-baked soil.

These, and a host of similar considerations, which have made under drainage popular in older countries, are of weight in California. Possibly, as a rule, because of our vast area of deep, kind loams, the proportion of land needing drainage in this State is less than elsewhere, and yet there is a vast extent of country to be improved by tiling. This fact is being constantly more widely recognized, and each year a greater mileage of under drains is put in.

Information on the construction of under drains is too available through other sources to call for its presentation in this connection. Of course, the best means of drainage are well-burned drain tiles of a size corresponding to the amount of water to be carried. Such tiles are now manufactured in this State with the aid of the latest improved machinery. When the planter is distant from tile factories, or wishes, for economy's sake, to use other materials, it is quite possible to make drains to serve a temporary purpose, at least, in this way: Flat stones

may be placed in the bottom of the trench so as to give a waterway; poles saved from clearing may be laid along in the trench, two at the bottom a little way apart, and the third placed on top so as to cover the opening; redwood boards, four to six inches wide, nailed together trough fashion, and then inverted on the bottom of the ditch—many such contrivances will drain the land, and will operate until filled by silt or plugged by ground pests. Even a trench filled with cobbles up to near the plow line, and then covered with brush and soil, will give egress to water; and even brush alone, if stones are not handy, will act for some time. There is abundant field for ingenuity, and if the main drains are placed in the lowest places and the laterals run about forty to fifty feet apart, and sunk, as a rule, about three and a half feet deep, there will usually be a quick removal of surplus water, providing the drains are run as they should be, with a perfectly uniform grade along the bottom line irrespective of the surface conformation.



DRAINS MADE WITH TILE, STONES, AND BOARDS.

MOLE DRAINS.—Where it is not feasible to put in permanent drains at once, the old practice of mole draining serves a good temporary purpose, and is used to some extent by growers of small fruits. The mole drain needs a soil of some adhesiveness to be successful in its work. Mole drains may be made in this way:*

Take a plow beam with handles; run down through the beam a bar of iron three and a half inches in width by five-eighths of an inch in thickness. This extends down from twelve to fifteen inches, and is to be raised or lowered at pleasure by bolts running through both beam and bar. To the lower end of the bar is fastened, by a link, a mole made of cast iron, well polished, about fifteen inches in length, and tapering from three and a half inches at the large and rear end to a point at the fore end where fastened to the link.

To use the mole, dig down with a spade to proper depth, insert bar and mole, hitch two horses, and run the mole in any direction desired, say up and down the garden six to eight feet apart. The mole dragging after the bar, opening the earth, presses the loose soil upward into the track of the bar above the mole, leaving a good open hole for irrigation or drainage purposes.

This is found to be of great practical advantage in the growing of such crops as strawberries, onions, and the like. The ground thus treated does not sun dry and crack, as when in irrigation the water is allowed to run on the surface. It renders unnecessary the cultivation usually resorted to after irrigation.

The mole drains, of course, only give drainage to a shallow layer of soil, and cannot, therefore, take the place of deeper conduits which are needed in orchard and vineyard.

*E. Leedham, Arroyo Grande, in *Rural Press*.

DRAINAGE AND IRRIGATION.—A special importance attaches to complete and systematic drainage in connection with irrigation. There is pressing need of such provision where the soil has become overloaded by seepage water from irrigation ditches, and it is well that people in such situations are waking up to the need of coupling drainage outlets with their irrigation inlets. Another matter closely allied to this is the action of alkali on soils thus artificially water soaked. This has been made the subject of a special publication by Professor Hilgard, to which allusion has already been made. Drainage is plainly essential, both in individual farms and in districts where the water level is rising too high, and the striking statements given in Professor Hilgard's report will incite all to insist that immediate attention be given to the needs of the State in this regard.

PART THIRD: ORCHARD FRUITS.

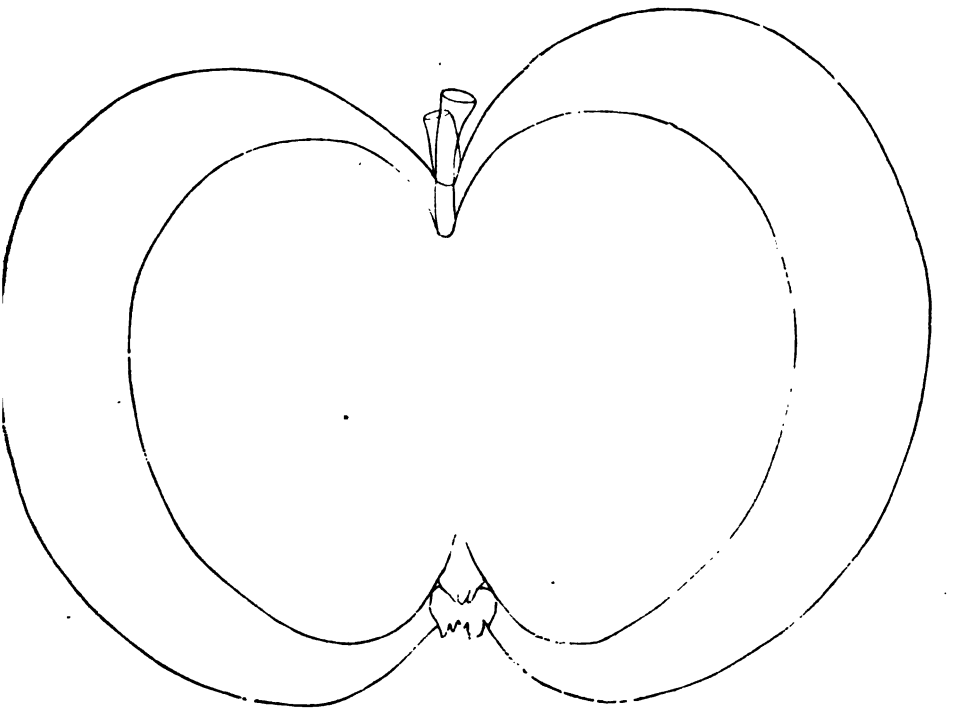
CHAPTER XVI.

THE APPLE.

THE apple has had a hard course to run in California, nor has it yet attained the place in the mind of the tree planter to which it is entitled. During the first decade more failures than successes were reported by those whose enterprise led them to import large collections of the best varieties from the Eastern States and Western Europe. Growers were naturally perplexed to find late winter varieties ripening in the autumn and quickly going to decay, as many of them did. Finding so many Eastern varieties with this behavior, collections were brought in from the Southern States for trial. With these, also, there were many disappointments. Hope in the apple, however, revived when it was found that a few varieties did show good keeping qualities, but sank again when these trusted sorts, though succeeding in some localities, failed in others, and so much confusion resulted in the popular mind that the verdict went forth that California was not adapted to the growth of good apples. Even to this day some may be found who will maintain such a view. The well-informed, however, believed otherwise, and even before the wonderfully satisfactory test of both Northern and Southern California apples at the New Orleans World's Fair, they had concluded that the right variety grown in the right place yields an apple in California than which a better cannot be grown anywhere.

One of the most obvious characteristics of California apples is large size. At one time it was almost conceded that this size was attained at the expense of all good qualities, and that the California apple was a coarse, dry, tasteless, and short-lived fruit. This conclusion was based upon fruit grown in localities not suited for the development of the good points of an apple, or by excessive use of irrigation water. More recently we are growing apples which far exceed the Eastern standards of size, and are at the same time possessed of the finest interior quali-

ties. The engravings beneath show the outline of the Tompkins County King, as grown in Sonoma County, surrounding the outline of the same variety grown in New York, as given by Downing. Both are supposed to be merely good-sized, and not extraordinary specimens.



THE TOMPKINS COUNTY KING, OF CALIFORNIA AND EASTERN GROWTH.

LOCALITIES FOR THE APPLE.

Speaking generally, it may be laid down that the great valleys of the interior are not well suited to the apple. Of course some varieties will do well enough to warrant planting them in family orchards, or for local sale, and in the early regions of the Sacramento Valley and foot-hills there is some profit in the better early varieties for shipment to the Territories, and beyond, as will be shown, but this demand would not call for large planting. In the great valley and lower foot-hill region of the State, the apple usually lacks character and keeping quality. On the great plains it is liable to sunburn, or sun blight, as it is called. Some varieties, because of the character of their foliage,

are less liable to this injury than others, and it is possible that this evil may be finally overcome by the selection of varieties with blight-proof foliage, as will be mentioned later. In the great valley, however, on the rich river bottom land of the Sacramento and the San Joaquin and its tributaries, the apple roots deeply, attains good size, bears good fruit, with fair keeping quality, while but a few miles away on the plains it would be inferior.

In the interior the region of adaptation to the apple lies at an elevation on the foot-hills on both the east and west rims of the great valley. Its limits are not well defined, but there are flourishing orchards at an elevation of about four thousand five hundred feet on the slopes of the Sierra Nevada Mountains, and from two thousand to three thousand five hundred feet is commonly regarded the best apple region of the mountains. The trees attain large size and bear heavily, and the fruit, of well-adapted varieties, is large, crisp, and juicy, and has exceptional keeping qualities.

Along the coast the apple succeeds well from end to end of the State. There is a certain advantage in elevation in the coast region as well as in the interior, but the advantage is not so marked nor is the required elevation so great. Coast valleys in the upper portion of the State, where the soil is suitable, produce most excellent apples, but even here the hillsides, with deep, well-drained soils, are, perhaps, preferable to the floors of the valley. As you depart from immediate coast influences and approach the interior, with its greater heat and aridity, the greater elevation becomes desirable. The apple, excepting the very early varieties, does not relish the forcing heat which brings such perfection to the peach, but to insure it late ripening and long keeping, with accompanying crispness, juiciness, and flavor, it must have atmospheric surroundings which favor slower development.

Localities for apple growing in Southern California are to be chosen with much the same rules as in the upper parts of the State. As has already been said, valleys in which coast conditions largely predominate produce good apples on suitable soils, but away from the coast proper, elevations must be sought, and they should be above the so-called thermal or frostless belts. Good apples are grown on low lands near the coast in Los Angeles County. Sixty miles inland, in San Bernardino County, winter apples fail in the valleys, but are most excellent at a sufficient elevation upon the slopes of the surrounding mountains. In the elevated interior of San Diego County, as in the Julian District, excellent apples are produced.

SECOND AND THIRD-CROP APPLES. There is a peculiar behavior of the apple tree, most noticeable where winter temperature is mildest, and that is blooming and fruiting out of season. The fact is made the basis of an argument that the climate is not suited for the apple, and that the tree needs a cold winter to secure it rest and normal blooming and bearing. However this may be, the attempts at bearing several crops in the year do not seem to seriously interfere with its growth nor fruiting. The following record* will serve as an illustration:—

There is an apple tree in Dr. C. C. Hartington's yard, in this city, which has already produced two ripe crops this season, and has the third crop half grown at this time. They are beautiful red apples, of a fine flavor. The first crop ripened by the first of July The tree, being large and prolific in its bearing, supplied the doctor's family and others in the neighborhood with apples for some time. After the first crop was gathered, the tree again blossomed, and the result of those blossoms is now being gathered. The third set of blossoms came on when the second crop was half grown.

This is not an isolated case, but double crops of apples are not of amount nor regularity enough to be of any great economic importance, as are the second crops of table and raisin grapes. The third crop sometimes ripens. Dr. H. C. Dimock brought to the editor of the Lompoc, Santa Barbara, *Record*, on January 9, 1886, "a handsome, well-matured apple of the Skinner seedling variety, eleven and a half inches in circumference, and a stem bearing six large, fine Siberian crab-apples. Both varieties of apples are samples of the third crop grown since last summer."

This behavior of the apple is most frequent during mild winters. Though some approve it, as has been stated, others consider it a decided objection. D. F. Newsom writes that in the Arroyo Grande valley apples do splendidly, but in the thermal belt in the hills are very poor, because the temperature is so mild that they bloom and bear all the year round.

EXPOSURES FOR THE APPLE.

The choice of exposure for an apple orchard may almost be inferred from what has been said about localities. In regions with high summer temperature the apple will do best on cool, northerly slopes, and this exposure becomes doubly desirable when the location has high temperature with only moderate annual rainfall, or where the soil is not well adapted to the retention of moisture. With such prevailing conditions, the apple will be grateful for the cooler air and the greater moisture of the northerly slope. Where the temperature is moderately cool, and the rainfall adequate, the matter of exposure is of less

*Marysville *Appeal*, Dec. 5, 1885.

account, and the grower can make the existence of the best soil the test of location of his orchard. At elevations on the sides of high ranges where late cold storms are liable to rush down from higher snow fields, protection from the usual course of such storms, or from the course of cold winds generally, must be sought; and directly upon the coast, especially in the northern part of the State, in certain places where the peach does not usually succeed, even the apple may need protection, and the benefit of all heat available, and then a southerly or southeasterly exposure becomes desirable. The choice of exposure is thus seen to be largely a local question and to be determined by a knowledge of local conditions. A new-comer in a region can best learn these conditions by conference with older residents, or by personal observation of older orchards.

SOILS FOR THE APPLE.

Experience with the apple in California confirms what has long been set forth as its choice of soils in older regions. If one avoid an extremely light, sandy soil on the one hand, and a very stiff clay or adobe on the other, he may plant apples on almost any soil which allows extension of the roots to a considerable depth without reaching standing water. The apple thrives in a moist soil, but it must be well drained, naturally or otherwise. A soil which may be called best for the apple is a deep, rich, moist, calcareous loam, but the tree will thrive on coarser materials. A comparatively shallow soil, even clay underlaid by gravel, has been shown to be good, and it is claimed that an apple root as thick as a man's wrist has been found twenty-eight feet below the surface in a gravel subsoil in this State. A subsoil of loose rock has also supported good apple trees, and the roots have taken wide lateral extension instead of depth. There seems, however, to be no exception to the rule that the subsoil, whatever its nature, must be sound and open to the passage of moisture. The most unfavorable condition for the tree is a subsoil of clay which holds water.

PLANTING AND CARE OF THE APPLE ORCHARD.

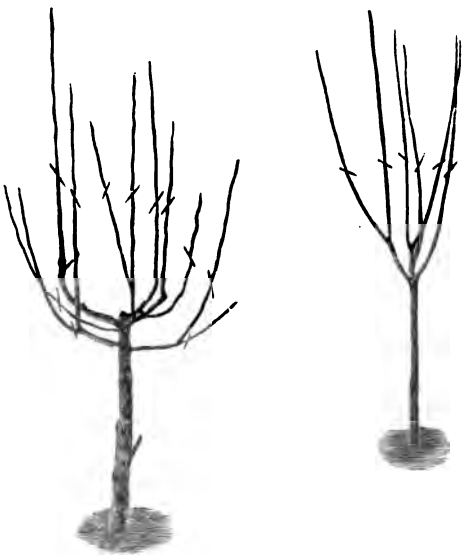
The chapters on propagation, planting, and pruning, contain suggestions to which the reader is referred. Care should be taken to obtain trees with clean, healthy roots, not knotted and scarred by woolly aphis.

DISTANCE IN PLANTING.—The distance between the trees is of the highest importance. All the old apple orchards which

the writer has seen in California are overcrowded. It was the practice to plant even standard trees twelve, fourteen, and sixteen feet apart, and where alternate rows have not been cut out, the most severe cutting back has not prevented the branches from interlacing. The overcrowding has resulted in stunted, gnarly, and, probably, short-lived trees. More recently trees have been set at greater distances, and such planting is now generally advised. There is some difference of opinion as to proper distance, but certainly twenty-five to thirty feet is near enough for the apple. Senator De Long, of Marin County, who owns one of the most celebrated apple orchards of the State, planted by his father in early days, has had full opportunity to judge of the disadvantage of close planting. and advises that apples be planted thirty-six feet apart, with apricots, or some other early bearing trees for which the soil is suited, between them, on the quincunx plan. The apples will not, as a rule, bear a paying crop, in his locality, until they are seven years old, while the other fruits will bear well the fourth year, and the trees will not seriously interfere until the apples are fifteen years old, and then the center trees can be cleared out and the full space given to the apples. In some parts of the State the trees will attain size much sooner than this. It is an open question with growers whether it is better to do this interplanting or to set the apples at twenty-five to thirty feet apart, and give them the whole ground.

PRUNING THE APPLE.—The manner of shaping fruit trees described in the chapter on pruning succeeds admirably with the apple. Yearling trees are usually planted, and they are headed back to eighteen, twenty, or twenty-four inchse, as the grower chooses. When the higher length is given the stem, a branch should be allowed to issue as low as twelve inches from the ground, and the others at about equal distances apart above them. Of course they should be on different sides, so as to balance the head evenly around the stem. These branches should all take an obliquely upward direction, and this can be promoted at the winter pruning after the first year's growth, by cutting to an *inside* bud all varieties which naturally take a horizontal direction, like the Rhode Island Greening, and cutting to an *outside* bud varieties which have a tendency to send up tall, straight shoots, like the Yellow Newtown Pippin, and others. By thus throwing the new growth upward in the first case, and outward in the second, you can shape each kind to greater symmetry and strength for fruit carrying, and bring up all spreading varieties to a form which admits near approach of the plow and

cultivator. This manner of shaping the tree must contiuue as long as seems necessary to secure the desired result.



RHODE ISLAND GREENING AND ESOPUS SPITZENBURG—SHOWING MANNER OF GROWTH AND PRUNING.

The engraving given herewith is from a photograph of two young trees in the writer's garden at Berkeley. The nearer tree is the Rhode Island Greening, which was pruned to upper buds to overcome its spreading habit, and the growth was thus made upright. As the marks for next pruning show, it is intended to cut next time to an outside bud to throw the branches outward again. The other tree is the Esopus Spitzenburg, an upright grower, which must be spread by cutting to outside buds. The grower must study every variety he has, and prune accordingly.

AGE OF TREES.—Apple trees which have been properly cut back in the nursery at the end of the first year's growth, may be planted out to good advantage, as two-year-olds, and even three-year-olds, properly pruned in nursery, may be used. These old trees, however, can only be safely commended to those who propose to take extra good care of their trees, as in the planting of village fruit gardens. For regular orchard planting, yearling trees are best.

All that has been said in the chapter on pruning of the advantages of low heading applies with full force to the apple tree. If the tree is thus started right, branches enough allowed to grow to balance the head well, but not to crowd each other, and these branches well cut back to throw out good laterals and to strengthen themselves, you will get a tree which will come to bearing age shapely and strong, and within reach. After such a tree begins to bear, there is usually little to do except to shorten in when the growth is excessive. This depends much upon variety. So long as branches several feet in length are

thrown out, there must be shortening in practiced, or else even a tree which was started well may run off into long, streaming branches which cannot hold up their fruit. Probably the best-behaved apple tree, and one of those best adapted to California conditions, is the White Winter Pearmain. It usually requires very little cutting after its shape has been formed. The Yellow Newtown Pippin, also one of the best apples for this State, requires constant watchfulness to check its streaming tendency. By watching these two sorts, as extremes, the grower will soon learn how to handle other varieties.

In regions of the most intense summer heat, less pruning is admissible than in the coast and elevated regions. It is necessary that the foliage be dense to protect the tree and the fruit from sunburn. Nor does the tree seem to relish cutting back. Slight thinning out, if the tree becomes too brushy, seems to be the best treatment in some of the hot valleys.

THINNING THE FRUIT.—One of the most important items in the handling of an apple orchard is the faithful thinning out of the fruit of all varieties which are prone to overbear. Although this work is tedious and expensive, it is profitable, because of the improved price which can be had for the larger fruit which will be secured, and it is desirable in the effects of thinning on the tree. It will be relieved from the exhaustion of overbearing, induced to yield annual crops, and often saved from breaking down with a too heavy burden.

GATHERING AND STORING APPLES.

The disposition in this State, as elsewhere, is to allow the fruit to hang too long upon the tree before gathering. It was long ago demonstrated that an apple for long keeping must be picked early. As late fall weather in California is so delightful, there is more temptation to delay the picking than where the approach of winter admonishes the grower to get his fruit under cover. Mr. De Long, who has had much experience in keeping apples, and in shipping them to Australia, says that picking apples for shipment should be done just when the seeds begin to blacken and when the fruit yields to pressure. If left on until fully ripe, and the seeds all black, it will not keep. This rule applies to fall apples for shipment to distant markets, or for apples to be stored at home.

Nearly all the ways of keeping winter apples have been tried in California. The tendency to shrivel towards spring has been overcome by embedding in gypsum, sand, and other materials. It has also been found by experience that apples keep

perfectly until late in the spring by piling under the trees and covering with leaves, etc., allowing the rains to fall upon them. They come out from the cover fresh, smooth, and plump, and for family use such rough storage will often answer a good purpose. For commercial storage, however, good fruit-houses are used. The requisites of such houses are an evenly cool temperature and good ventilation, the fruit being open to free access of the air. A fruit house for apples, described by Milton Thomas in an essay at a meeting of the Los Angeles Pomological Society, in 1886, may serve as a model for such structures: "The best apple house should be built with double walls, twelve inches apart, and this space should be filled and packed well with straw. Then there should be a double roof, twelve inches apart, on the same general plan as the sides. Then double doors, and use every precaution to keep the house cool as possible. Then place the apples on shelves, or in apple boxes. Have ventilators to use at night."

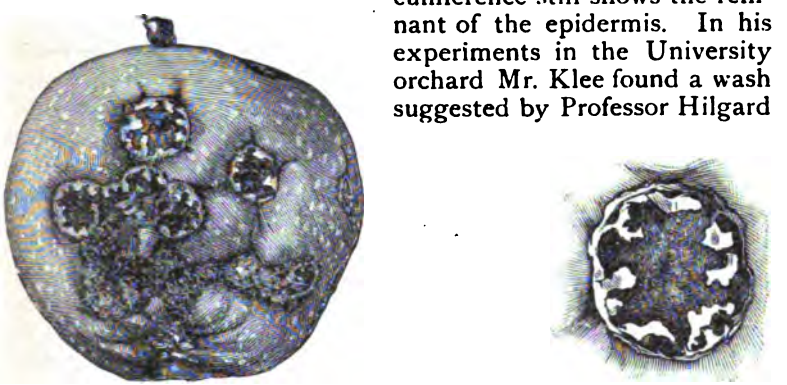
Of course, in selecting apples for storage, all windfalls should be rejected. The fruit should be carefully picked and handled, without bruising. The advantage of spreading on shelves, aside from the free admission of air, is the ease with which the fruit can be examined and all decaying specimens removed.

MARKETING APPLES.—With well-grown fruit, from an orchard free from insects, or one in which they are resolutely repressed, and the apples properly stored for winter and spring sale, there is a rich reward for the apple grower. The market is free from everything but late pears and citrus fruits, and they cannot replace the apple in popular esteem. Let the fruit be carefully selected and graded into firsts and seconds as to size, and let the brand get the reputation of covering nothing but sound fruit of honest uniformity throughout the package, and in the long run the apple grower will not be ashamed to compare his returns with those of the grower of other fruits—providing, as we have already intimated, he is growing the right varieties in the right place.

THE APPLE SCAB OR SMUT.

In the coast region, for many years, some varieties of the apple have been afflicted with a disease which causes unsightly blotches on the fruit, and blights the leaves. The late W. G. Klee, while Superintendent of the University orchard in Berkeley, gave much attention to the subject, and found that the smut of the pear was due to the same agency

as the scab of the apple, the growth of a fungus known as *fusicladium dentriticum*. The accompanying engravings are from a bulletin on the subject issued by Mr. Klee.* They show the work of the fungus on a White Winter Pearmain: (*a*) the fruit in its natural size; (*b*) a blotch enlarged; both show plainly the rapid spread of the fungus destroying the tissue of the apple. The center is black with millions of growing spores; the circumference still shows the remnant of the epidermis. In his experiments in the University orchard Mr. Klee found a wash suggested by Professor Hilgard



SMUT OR SCAB OF THE APPLE.

very effective. Its composition and method of application are as follows:—

Dissolve thirty pounds of whale-oil soap (eighty per cent soap, at the most costing five cents a pound) in sixty gallons of water, by heating the two together thoroughly. Then boil three pounds of American concentrated lye with six pounds of sulphur and a couple of gallons of water. When thoroughly dissolved it is a dark brown liquid, chemically called sulphide of soda. Mix the two—the soap and the sulphide—well, and allow them to boil for half an hour. Then add about ninety gallons of water to the mixture, and it is ready for use. Apply it warm, by means of a spray pump. Used warm, its effect is better and less material is required than when cold.

SELECTING VARIETIES.

For the family orchard there should be a selection of quite a number of varieties, ripening in succession, from the earliest to the latest. Which are best in the different parts of the State can be approximately determined from the tabular statement which will follow, and which has been compiled from the experience of hundreds of apple growers.

The selection of varieties for a commercial orchard is a very different proposition. Only a few kinds should be chosen, with special reference to their growth and bearing, and the markets for which they are intended.

*"Rep. Cal. State Board Hort.," 1887, p. 408.

SUMMER AND FALL APPLES.—In some regions noted for early maturing of fruit, it is profitable to grow a certain quantity of early apples, providing there are facilities for reaching profitable avenues of trade. For example, early and fall apples are profitable in the Sacramento Valley and on the foot-hills up as high as Colfax. A profitable apple in the Sacramento Valley is the White Astracan, which can be shipped *early* as far east as Omaha. Alexander, Skinner's Seedling, and Gravenstein also do well for this trade, the first two being best. In June as high as $1.40 per forty-pound box was paid in 1887, in Marysville, for White Astracan, to ship East, and from $1.00 to $1.50 has been paid for such fruit for the last six years. This demand may be limited, but present shipments can, doubtless, be largely increased.*

Except to minister to some special local or distant trade which can be thus foreseen, it must be said that early summer and fall apples are hardly worth the attention of the commercial planter. These sorts are apt to come into direct contest with the magnificent peaches, grapes, and other summer and autumn fruits and suffer thereby. In San Francisco this is notably the case, but as the State is filling up, and many interior towns offering local markets for fruit, the planter may often profitably sell a few early apples for near-by consumption.

WINTER APPLES.—For large ventures in apple growing, in localities carefully chosen for especial adaptations, a few of the finest varieties of winter apples should be selected. These, as reported from the different counties, can be learned from the table. It is the judgment of the most experienced apple growers, many of whom have old orchards including many varieties, that new plantations of winter apples should contain only about six sorts. Of these, in all parts of the State, three would be the Yellow Newtown Pippin, White Winter Pearmain, and Yellow Bell Flower; the other half of the half dozen would be differently made up in different parts of the State.

APPLES FOR SOUTHERN CALIFORNIA.—The Southern California Nurserymen's Association, in November, 1886, named the following selection as succeeding in the southern counties, and giving a succession of apples from July to March: Early Harvest, Red Astracan, Fall Pippin, Skinner's Seedling, Gravenstein, Rhode Island Greening, Yellow Newtown Pippin, White Winter Pearmain, Yellow Bell Flower, Ben Davis, and Jonathan. The whole list gives the succession for family orchards, but only the last five are commended for commercial orchards.

*Robert Williamson, at meeting of State Horticultural Society.

APPLES FOR LONG SHIPMENT BY SEA.—There has been for years quite an important trade in shipment of California apples to various ports in the South Pacific Ocean, and recently there has been receipts of very good apples from Australia, in this State. As the regions are in the northern and southern hemispheres, their seasons are opposite, and there seems an opportunity for profitable exchange of fruits which will endure long shipment. A large proportion of the apples shipped from California for South Pacific ports have been packed in the De Long orchard, in Marin County. As to the carrying qualities of the different varieties, Honorable F. C. De Long gives the following as the result of his experience: But few varieties are safe to ship. The Yellow Newtown Pippin is best, the red-cheeked Pippin (Monmouth Pippin) is good, so are Esopus Spitzenberg, Smith's Cider, Winesap, Swaar, Northern Spy, Jonathan, White Winter Pearmain, and the Roxbury Russet if it can be shipped immediately, but it cannot be held for future shipment. The Summer Pearmain and the Gravenstein are not satisfactory. Mr. De Long's idea of the proper condition at picking has already been cited.

FOR THE INTERIOR VALLEYS.—In choosing varieties for the hot valleys of the State those making a heavy leaf growth are to be preferred. The Spitzenberg, for example, is a failure in the valleys of the interior. From experience already had it seems likely that some of the Russian varieties, with thick, large leaves, will prove best for such situations. Professor J. L. Budd, of the Agricultural College of Iowa, who has given great attention to the structure and behavior of the Russian fruits, believes that the same characteristics of growth which give them hardiness in the Northwest will also sustain them in the extreme heat of the interior of California. This must be demonstrated by actual experience, but the behavior of the Astracans, the Duchess of Oldenburgh, and others of Russian origin, seems to indicate truth in the surmise. Rev. Mr. Loop, of Pomona, who has tried many varieties of the apple, pronounces the "Polo," a Russian sort, the best he grows.

THE SURVIVAL OF THE FITTEST.—It would be interesting to review the peculiar behavior which certain varieties have exhibited under different conditions in this State, but the results would not be practically important enough to warrant it. The lists which will be presented, as approved varieties in different parts of the State, will mark the survival of the fittest. It is easy now, profiting by the experience of the last thirty years, to choose a list of varieties, made up of some of the best old

standard varieties, together with some seedlings of California origin, which will give very satisfactory results in any place where the local conditions are fitted to the apple.

THE PRICE OF SUCCESS.—Even before the question of varieties and locations was as well understood as now, another perplexity arose before the apple grower, in the form of the codlin moth, which was, probably, introduced in larval form with some fruit brought from several Eastern States in 1871, for exhibition at our State Fair, in comparison with California fruit. The spread of this pest to nearly all parts of the State, and the rapidity of its increase, owing to our favorable climate, has brought dismay to many apple growers and has led to the cutting out of some orchards, where the owners preferred to introduce some other fruit than to fight the worm.

These very difficulties, however, if rightly appreciated and met, will prove the key to profit in the growth of the apple. To choose the best location for good late-keeping apples, to plant the best varieties, and to protect them from insects, as can be done if one will take the pains to follow the instructions which will be given in another chapter, must be regarded as quite as promising a venture in the long run as can be made in California fruit growing.

VARIETIES CHIEFLY GROWN IN CALIFORNIA.

Of the hundreds of varieties of apples tested in California, comparatively few are now grown, as has already been suggested. Those named below have been reported by growers as succeeding in the localities named with the description, or indicated in the table which will follow. The descriptions of the standard sorts are, in the main, condensed from Downing,* with local notes interpolated when thought necessary. The arrangement is, approximately, in the order of ripening.

YELLOW JUNE.—(Southern.) Below medium, roundish; pale yellow, thickly sprinkled with green and brown dots; stalk long, slender; core small; flesh white, tender, sprightly subacid. Approved in Tehama County.

CAROLINA RED JUNE.—(Southern.) Medium size, oval, irregular, inclined to conic; deep red covered with light bloom; stalk in small cavity; calyx closed; flesh white, tender, juicy, subacid; core rather large. (See table.)

WHITE JUNEATING; syn. *Jennetting*, *Gennetting*, etc.—Small, round, a little flattened, calyx closed; stalk rather long and slender; pale green, changing to yellow, sometimes with faint blush, crisp and pleasant. Approved in Humboldt and Mendocino Counties.

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* "Downing's Fruit and Fruit Trees of America," John Wiley & Sons, New York; edition of 1886.

EARLY HARVEST.—(American.) Medium size, roundish; straw color, with few faint white dots; stalk half to three-fourths inch, slender, set in moderate cavity; calyx in shallow basin; flesh very white, tender, crisp, pleasant. (See table.)

EARLY STRAWBERRY.—(New York.) Medium size, roundish, narrowing towards the eye; skin smooth, deep red on yellow ground; stalk one and a half inches, rather slender and uneven, in deep cavity; calyx small, in shallow basin; flesh white, tinged with red next the skin, tender, subacid, sprightly. (See table.)

LARGE EARLY BOUGH; syn. *Sweetbough.*—(American.) Large, oblong, ovate, smooth; pale, greenish yellow; stalk rather long; eye narrow and deep; flesh white, tender and crisp, with rich, sweet flavor; young shoots grayish brown, very slightly downy. Approved in Santa Barbara County.

SUMMER QUEEN.—Large, broad at top, and tapering towards the eye; stalk long, in deep cavity; calyx but little sunk; skin deep yellow, striped and clouded with red; flesh yellow; aromatic. (See table.)

RED ASTRACAN.—(Russian.) Large, roundish; skin deep red, save greenish yellow in the shade; pale white bloom; stalk short, and deeply inserted; calyx partially closed and set in slight basin; flesh white, juicy and crisp, pleasant acid; tree hardy and vigorous, and an early bearer. The main reliance in California for an early apple. (See table.)

WHITE ASTRACAN.—(Russian.) Large, roundish; skin smooth and nearly white, with faint streaks of red, and covered with white bloom; flesh white. Considerably grown in the Sacramento Valley, for early shipment.

LYMAN'S LARGE SUMMER.—(American.) Large, roundish, flattened at the ends; skin smooth, pale yellow; flesh yellow, tender, subacid. Approved in Santa Cruz County.

EARLY JOE —(New York.) Medium size, oblate, smooth, yellowish, shaded and striped with red, and thickly sprinkled with greenish spots; stalk medium, in large cavity; calyx closed; flesh whitish, tender, juicy, vinous. Approved in Mendocino County.

DUCHESS OF OLDENBURG.—(RUSSIAN.) Large, roundish, oblate; yellow, streaked with red; calyx large, nearly closed, set in wide, even hollow; flesh juicy, subacid. Approved in Monterey and Los Angeles Counties.

GRAVENSTEIN.—(GERMAN.) Large, rather flattened; a little one-sided or angular; broadest at the base; stalk short, strong, deeply set; calyx large, closed, in a large basin; skin yellow, freely marked with light and deep red and orange; flesh tender, crisp, high-flavored, aromatic; a strong-growing and heavily-bearing tree; a standard fall apple in this State; not approved for higher Sierra district. (See table.)

KESWICK CODLIN.—(English.) Large, rather conical, with few obscure ribs; stalk short and deeply set; calyx rather large; greenish yellow, with faint blush; flesh yellowish white, juicy, pleasant acid. Approved in Mendocino and Contra Costa Counties.

PORTER.—(Massachusetts.) Rather large, regular, oblong, tapering to the eye; clear, bright yellow, with dull blush; calyx closed, and set in narrow, deep basin; stalk rather slender, less than three-fourth inch long; flesh fine grained, juicy, aromatic, subacid. (See table.)

RED BIETIGHEIMER.—(German.) Large to very large, oblate, slightly conical, regular; smooth, whitish, or yellowish white, shaded with light and dark red and purplish crimson in the sun: stalk short, rather stout; calyx closed in large, deep, slightly corrugated basin; flesh white, firm, juicy, brisk subacid; lately introduced. Approved in Sonoma County.

GOLDEN SWEET.—(Connecticut.) Large, roundish, pale yellow; stalk about one inch, slender at the base; calyx closed, in basin of moderate depth; flesh tender, sweet, and rich. (See table.)

AMERICAN SUMMER PEARMAIN.—Medium to large, oblong; yellow and red in spots and stripes; stalk three-fourths inch, pretty deeply inserted; calyx closed and deeply sunk; flesh yellow, tender. ("A rich, highly-flavored fruit, ripening gradually for a period of six weeks."—John Rock.) Approved in Napa, Alameda, and Placer Counties.

MAIDEN'S BLUSH.—(New Jersey.) Rather large, smooth, regular; yellow, with evenly-shaded red cheek; stalk short, in rather wide, deep hollow; calyx closed in moderate depression; flesh white, tender, sprightly. (See table.)

PRESIDENT.—(New Hampshire.) Large, roundish, pale yellow, tinge of red in the sun, and few gray dots. Approved in Del Norte County.

HOLLAND PIPPIN.—Very large, roundish; stalk half inch, deeply sunk; calyx small, closed, moderately sunk; greenish yellow, becoming pale yellow with slight brownish blush and a few scattered, large, greenish dots. ("One of the best apples of the season."—James Shinn.) (See table.)

SPICE SWEET.—Medium sized, pale yellow; flesh firm, sweet, very arom . Approved in Humboldt and Sierra Counties.

CHENANGO STRAWBERRY.—(New York.) Medium, oblong conic, indistinctly ribbed; whitish, shaded, splashed, and mottled with light and dark crimson; light dots; stalk rather short and small; calyx closed or partially open; flesh white, tender, mild subacid. Approved in Humboldt County.

WASHINGTON STRAWBERRY.—(New York.) Large, roundish conical, flattened at base; yellow, shaded, splashed and mottled with red; stalk short; calyx closed in a basin, deep, abrupt, and furrowed; flesh yellow, crisp, tender, subacid. Approved in Mendocino, Alameda and Santa Cruz Counties.

FALL WINE.—Medium to large: red stripes and shading on light ground, with numerous russet dots; stem long, slender, in broad, deep cavity; calyx partly closed, in deep, broad, corrugated basin; flesh yellowish, juicy, tender, rich, aromatic, very mild subacid. Approved in Napa and Alameda Counties.

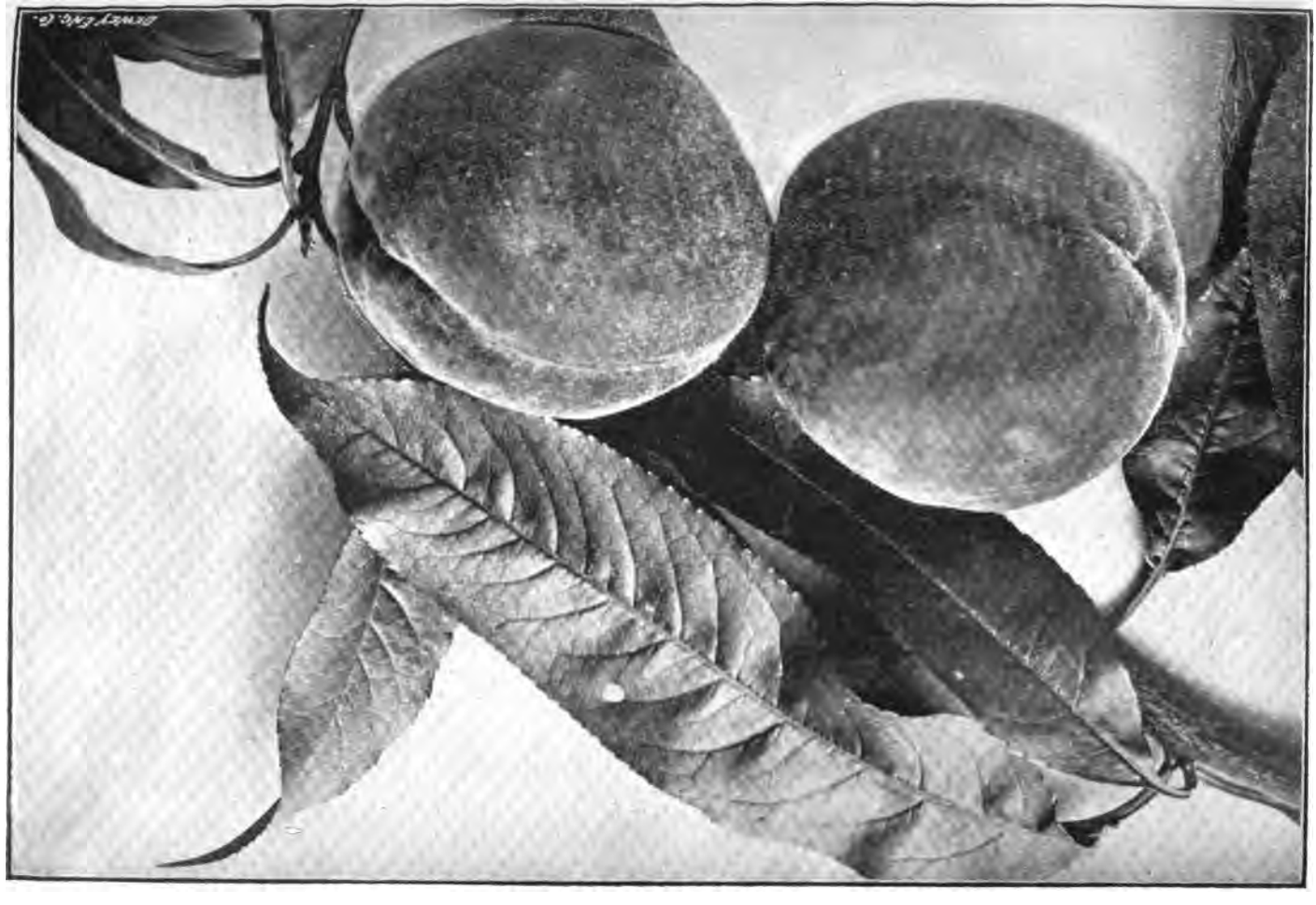
FALL PIPPIN.—Very large, roundish, a little flattened; stalk three-fourths inch, projecting considerably beyond the fruit (which distinguishes it from the Holland Pippin); calyx open, not very large, rather deeply sunk in round, narrow basin; skin smooth, yellowish green, becoming pure yellow; brownish blush and few scattered dots; flesh white, tender, mellow, rich, aromatic. (See table.)

ALEXANDER.—(Russian.) Very large, showy, conical, greenish yellow, streaked with red in shade, bright red in the sun; calyx large, in deep basin; stalk slender, long, in deep cavity; flesh yellowish white, crisp, tender, and juicy. Tree vigorous, but not always a good bearer. (See table.)

GOLDEN RUSSET.—(English.) Medium size, roundish; skin rough, yellow, mostly covered with dull russet, with bronze cheek in the sun; stalk short, sma l, calyx closed; flesh whitish yellow, fine grained, compact, sprightly, mild subacid. (See table.)

SMOKEHOUSE.—(Pennsylvania.) Large, roundish oblate; yellow shaded and splashed with crimson, with large gray and brown dots; stalk rather long, curved, in broad cavity; calyx closed, in wide basin; flesh yellowish, crisp, juicy, rich subacid. Approved in Alameda and San Luis Obispo Counties.

NONSUCH.—(Hubbardston.) Large, roundish; smooth, yellowish, splashes and broken irregular stripes of red; calyx open; stalk short; flesh juicy, tender, sweet, and rich; tree a vigorous grower, but held to be small in bearing in some localities. (See table.)



BEAUTY OF KENT.—(English.) Very large, roundish, but flat at base; greenish yellow, with large broken stripes of purplish red; stalk short, slender; calyx small; juicy, crisp, tender, subacid. Approved in Lake County.

TWENTY OUNCE; syn. *Cayuga Red Streak.*—(New York.) Very large, roundish, slightly uneven; greenish yellow, boldly splashed and marbled with purplish red; stalk short, in wide, deep cavity; calyx small; flesh rather coarse, but brisk, sprightly, subacid flavor. (See table.)

LATE STRAWBERRY; syn. *Autumn Strawberry.*—(New York.) Medium, roundish; whitish, striped and splashed with light and dark red; stalk rather long, slender, curved; flesh yellowish white, tender, juicy, vinous; tree vigorous and productive. Approved in Alameda, Santa Clara, and Yuba Counties.

GLORIA MUNDI.—Very large, roundish, oblate; ribbed; greenish yellow. A popular show apple on account of great size attained in this State. (See table.)

FAMEUSE; syn. *Snow Apple.*—(Canada.) Medium size, roundish, somewhat flattened; deep crimson, nearly concealing pale yellowish ground; flesh snowy white, tender, juicy, slight perfume; stalk slender, one-half inch, in narrow, funnel-shaped cavity; calyx small, in shallow rather narrow basin; "tree vigorous, with dark wood; one of the finest dessert fruits; succeeds particularly well in the foot-hills."—John Bidwell. (See table.)

KING OF TOMPKINS COUNTY.—Large, globular, angular, inclining to conic, yellowish, mostly shaded with red, striped and splashed with crimson; stalk short and stout, in large, somewhat irregular cavity; calyx small, closed; flesh yellowish rich, juicy, vinous, aromatic. "Subject to water core in some localities."—James Shinn. (See table.)

DETROIT RED.—Medium to large, roundish, bright crimson, becoming dark purple; dotted and marbled with specks of fawn on sunny side; flesh white, sometimes stained with red to the core. Approved in Santa Clara and San Luis Obispo Counties.

RAMBO.—(Pennsylvania.) Medium to large, flat; yellowish white with pale yellow and red in the sun, with large, rough dots; stalk long, rather slender, curved, deeply set; calyx closed, in broad basin; flesh greenish white. Reported a failure in some counties. "This apple, so popular in the Eastern States, does not fully sustain its high character on this coast."—James Shinn. (See table.)

ROXBURY RUSSET.—(Massachusetts.) Large, roundish, flattened, slightly angular; skin rough, greenish, more or less covered with russet; flesh greenish white, moderately juicy; stalk nearly three-fourths of an inch, rather slender, not deeply set; calyx closed. Reported a failure in some counties; ripens early and has poor keeping quality. (See table.)

BEN DAVIS.—Large, roundish, sides often unequal; light red and deep red on yellowish ground; stalk medium, rather slender, in deep, narrow cavity; calyx partially open. Commended as a market apple by the Southern California Nurserymen's Association. (See table.)

BALDWIN.—(Massachusetts.) Large, roundish, narrowing a little towards the eye; deep bright red over a yellow ground; few russet dots; calyx closed and set in narrow basin; stalk one-half to three-fourths inch, rather slender, set in deep, even cavity; flesh yellowish white, crisp, juicy, subacid. Best in northern and elevated regions; coloring varies greatly according to locality. (See table.)

HOOVER.—(South Carolina.) Large, roundish, slightly oblique; yellowish, mostly overspread with red, with conspicuous light dots; stalk rather long, in large cavity; calyx open in furrowed basin; flesh yellowish, juicy, crisp, acid. (See table.)

DUCKETT.—(Southern.) Large, oblate, waxen yellow with crimson cheek; flesh white, tender, juicy, aromatic; tree a fair grower and healthy; commended in Alameda and Inyo Counties.

RHODE ISLAND GREENING.—Large, roundish, a little flattened, pretty regular; dark green, becoming yellowish green; calyx small, woolly, closed, in shallow basin; stalk three-fourths inch, curved, thickest at the bottom; flesh yellow, fine grained, tender, crisp, juicy, aromatic, slightly acid; tree healthy and the variety widely popular. (See table.)

BAILEY'S SWEET.—(New York.) Large, roundish, conical; yellowish, shaded and striped with red; thickly sprinkled with minute dots; stalk short, small, in narrow cavity; calyx small, closed; flesh white, mild, sweet flavor; approved in San Luis Obispo, Tulare and San Bernardino Counties.

MONMOUTH PIPPIN; syn. *Red Cheek Pippin.*—(New Jersey.) Large, oblate, inclining to conic, slightly flattened at base and crown; pale yellow with blush and russet dots; stalk rather short, in large cavity; calyx partly closed in a deep basin; flesh juicy, brisk, subacid; approved in Sonoma, Contra Costa, and San Bernardino Counties.

VANDEVERE; syn. *Newtown Spitzenburgh.*—Medium size, oblate, slightly conic; fine yellow, washed with light red, striped and splashed with dark red, and shaded with carmine in the sun; light bloom and peculiar gray specks; stalk short, in wide cavity; calyx small, closed; flesh yellow, rich, sprightly, vinous. (See table.)

JONATHAN.—(New York.) Medium to large, roundish, conical or tapering to the eye; light yellow nearly covered with red stripes and deep red in the sun; stalk three fourths of an inch, rather slender, in deep, regular cavity; calyx in deep, broad basin; tender, juicy, rich, vinous; a great favorite in California; specially commended as a market apple by Southern California Nurserymen's Association; keeps till midwinter. (See table.)

WINESAP.—Medium size, roundish oblong; dark red with traces of yellow in the shade; stalk nearly an inch, slender, set in an irregular cavity; calyx small, in regular basin; flesh yellow, crisp; high, rich flavor; largely grown; tree a good bearer. (See table.)

ORTLEY; syn. *White Bellflower*, etc.—(New Jersey.) Large, oblong, greenish yellow, becoming fine yellow with slight blush; stalk medium, slender, set in deep, acute cavity; calyx closed, set in abrupt, corrugated basin; flesh white, fine-grained, juicy, subacid. Approved in Alameda, Santa Clara, Butte, Santa Barbara, and San Bernardino Counties.

BLUE PEARMAIN.—Very large, roundish, very slightly conical; dark purplish red over dull ground, appearing bluish from white bloom; flesh yellowish, mild aromatic. Approved in Siskiyou, Lake, Los Angeles, and Mariposa Counties.

SWAAR.—(New York.) Large, roundish; golden yellow with numerous brown specks; stalk slender, three-fourths inch, in very round cavity; calyx small, greenish, set in shallow basin; flesh yellowish, fine-grained; very rich, aromatic flavor and spicy smell. (See table.)

LAWYER.—Large, roundish, oblate, dark red, covered with small dots; stalk medium, cavity deep, regular; calyx small, closed, in medium furrowed basin; flesh white, sprightly, aromatic; a promising, late-keeping variety. Approved in Yuba and Santa Cruz Counties.

BUCKINGHAM; syn. *Equinetely.*—Medium to large; oblate, inclined to conic; greenish yellow, mostly covered, shaded, striped and splashed with red; many light brown dots; stalk short, cavity broad and deep; calyx closed; flesh yellowish, juicy, subacid. Approved in Alameda and Fresno Counties.

COOPER'S MARKET.—Medium, oblate conic, yellowish, shaded with red and striped with crimson; stalk short, in deep, narrow cavity; calyx closed in small basin; flesh white, tender, subacid. Approved in Inyo and Santa Cruz Counties.

RED CANADA; syn. *Steele's Red Winter.*—Medium to large, oblate, inclining to conic; yellow, shaded with deep red or crimson, and striped on sunny side; gray or greenish dots; stalk short, in broad, deep cavity; calyx closed; flesh white, tender, crisp, and juicy. Approved in El Dorado, Santa Barbara, and Inyo Counties.

YELLOW BELLFLOWER.—(New Jersey.) Very large, oblong, irregular, tapering toward the eye; smooth; lemon color, with blush; stalk long and slender in deep cavity; calyx closed, in rather narrow basin; flesh tender, juicy, crisp, with sprightly, subacid flavor; keeps well into the winter; tree a strong grower and healthy; one of the universal favorites in California. (See table.)

GOLDEN PEARMAIN.—(English.) Medium, roundish, conical; yellow, orange in sun; flesh yellowish, firm, crisp, juicy, sweet. Approved in Tuolumne County.

GRIMES GOLDEN PIPPIN.—(Virginia.) Medium to large, roundish oblate, slightly conical; golden yellow; stalk rather short and slender; calyx closed or partially open, in an abrupt, uneven basin; flesh yellow, compact, crisp, rich and spicy, with peculiar aroma. Approved in Alameda, Contra Costa and Inyo Counties.

WAXEN.—(Virginia.) Medium, roundish, slightly oblate, pale yellow, oily, sprinkled with a few dots; stalk slender, in a deep cavity; calyx closed in shallow basin; flesh whitish yellow, crisp, tender, juicy, sprightly, mild subacid. Approved in Del Norte and Siskiyou Counties.

ROMANITE.—Small to medium, roundish conical, truncated; yellow, mostly covered with clear, handsome red; indistinct light dots; stalk slender; calyx in an abrupt basin; flesh yellowish, fine-grained, juicy, pleasant, subacid. (See table.)

AUTUMN PEARMAIN.—Medium, roundish; brownish yellow with green on shaded side; reddish mixed with yellow and streaked with red on sunny side; numerous small brown specks; stalk short, obliquely set under a fleshy lip; calyx small, in broad, shallow basin; flesh pale yellow, crisp, firm, inclined to be dry, but rich-flavored. Approved in Siskiyou and Tuolumne Counties.

ESOPUS SPITZENBERG.—(New York.) Large, oblong, tapering roundly to the eye; smooth, nearly covered with rich, lively red, dotted with distinct yellowish russet dots; on shaded side, yellowish ground with streaks and broken stripes of red; stalk rather long, three-fourths inch, slender, projecting beyond the base and inserted in wide cavity; calyx small and closed, in shallow basin; flesh yellow, rather firm, crisp, juicy, with a delicious rich, brisk flavor. A largely-grown variety; tree a good, upright grower and healthy; fruit keeps fairly. (See table.)

SHOCKLEY.—(Georgia.) Medium, roundish conical; pale yellow overspread with red, inconspicuous minute dots, stalk long, slender, inserted in a deep acute cavity; calyx partly closed in shallow corrugated basin; flesh crisp, juicy, rich, vinous, pleasant. Approved in Fresno and Los Angeles Counties.

PECK'S PLEASANT.—(Rhode Island.) Large, roundish, a little ribbed and slightly flattened; indistinct furrow on one side; smooth, clear yellow, with bright brownish blush; stalk peculiarly fleshy and flattened; short, and sunk in a wide, wavy cavity; calyx woolly, pretty deeply sunk; flesh yellowish, fine grained, juicy, crisp and tender, deliciously aromatic, subacid. Approved in Del Norte, Napa, and Inyo Counties.

SMITH'S CIDER.—(Pennsylvania.) Large, roundish, oblate conic; yellow, shaded and striped with red, sparsely covered with gray dots; stalk slender, in deep, rather narrow cavity; calyx closed, in broad, shallow basin; flesh whitish, juicy, crisp, acid; tree a strong grower, and fruit keeps till midwinter. "One of the best of our apples for cooking or eating."—James Shinn. (See table.)

LIMBER TWIG.—Medium to large, roundish oblate, inclined to conic; greenish yellow, shaded and striped with dull crimson, light dots; stalk medium, in broad, deep cavity; calyx closed, in small, uneven basin; flesh whitish, juicy, subacid. "Valuable for great productiveness, hardihood and long keeping."—John Rock. Approved in Mendocino, San Benito, Tulare, Yuba and Butte Counties.

ROME BEAUTY.—(Ohio.) Large, roundish, approaching conic; yellow, shaded and striped with bright red, sprinkled with light dots; stalk one inch, in large, deep cavity; calyx partially closed, in deep, narrow basin; flesh yellowish, juicy, sprightly; fruit keeps late. Approved in Alameda, Sonoma, Santa Barbara, and Placer Counties.

NICKAJACK.—(North Carolina.) Large, roundish to roundish oblate, slightly conic, sometimes oblique; yellowish, freely striped and splashed with red; many large dots; stalk short, in large cavity; calyx partly open; flesh yellowish, fair quality; reported a shy bearer in high altitudes. (See table.)

FALLAWATER; syn. *Tulpehocken.*—(Pennsylvania.) Very large, globular, inclined to conic; yellowish green, shaded with dull red and sprinkled with large, gray dots; stalk very short, inserted in deep cavity; calyx small, closed, set in slightly plaited basin; flesh greenish white, juicy, pleasant, subacid. Approved in Humboldt and Napa Counties.

NORTHERN SPY.—(New York.) Large, roundish, oblate conical; pale yellow, purplish red stripes in the sun; stalk three-fourths inch, slender, in wide, deep cavity; calyx small, closed; flesh white, mild, pleasant; highly esteemed in a few localities, but abandoned in others for shy bearing. (See table.)

RED WINTER PEARMAIN.—Medium to large, roundish oblong conic; yellowish white, mostly shaded with maroon and thickly sprinkled with large, light dots; stalk very short in an acute, deep cavity; calyx closed, in small, round, open basin; flesh whitish yellow, tender, juicy, aromatic; tree healthy, and fruit keeps well. (See table.)

WHITE WINTER PEARMAIN.—Large, roundish oblong conic, somewhat oblique; pale yellow with slight blush; many minute brown dots; stalk short, in deep cavity; calyx nearly closed; flesh yellowish, tender, crisp, juicy, very pleasant subacid, extra high flavor; grown everywhere, and fruit keeps late; tree a strong grower and healthy. (See table.)

VIRGINIA GREENING.—Large, oblate, greenish yellow, thickly covered with brown dots and a slight blush; stalk rather long, in a large cavity; calyx open, in broad basin; flesh yellow, compact, pleasant, subacid. Approved in Sonoma and San Benito Counties.

LADY.—(French.) Small, regularly formed, flat; smooth and glossy, with brilliant red cheek contrasting with lemon yellow ground; flesh white, crisp, juicy and pleasant; chiefly used for ornamental purposes. Approved in Sonoma County.

RAWLES JANET.—(Virginia.) Medium to large, oblate conic; yellowish, shaded with red and striped with crimson; stalk short and thick, in broad, open cavity; calyx partially open, in shallow basin; flesh yellow, tender, juicy, pleasant vinous flavor; tree healthy and prolific. (See table.)

WAGENER.—(New York.) Medium to large, yellow, mostly covered with crimson, obscurely striped and sprinkled with light dots; stalk nearly an inch, rather slender, in large, broad, irregular cavity; calyx small and closed; flesh yellowish, very tender, juicy, excellent high flavor. Commended for frosty places as a very late bloomer. (See table.)

KENTUCKY RED STREAK.—Medium, roundish, slightly inclined to conic, greenish yellow, shaded with dull purplish red and indistinctly splashed and striped, thickly sprinkled with large light dots, having gray centers; stalk medium; calyx closed; flesh whitish, tender, juicy, mild subacid. Approved in San Benito, Los Angeles and San Bernardino Counties.

STARK.—Large, roundish, inclined to conic; sometimes elongated, sometimes oblique; greenish yellow, nearly covered with dark red and sprinkled with light and brown dots; stalk short, rather stout; calyx closed; flesh yellowish. Approved in Santa Barbara and Tulare Counties.

AMERICAN PIPPIN; syn. *Grindstone.*—Medium, regular, oblate; dull red in patches on green ground; flesh white, firm, juicy, with brisk, acid flavor. Approved in San Benito County.

GREEN NEWTOWN PIPPIN.—(New York.) Medium, roundish, little irregular, caused by two or three obscure ribs on the sides; dull green, becoming olive green when ripe, with faint, dull, brownish flush on one side; dotted with small gray specks; stalk slender and deeply sunk in a wide cavity; flesh greenish white, very juicy. Approved in San Benito County. This apple seems as obscure in this State as its congener, the following, is prominent.

YELLOW NEWTOWN PIPPIN.—Large, roundish, oblate and oblique, more or less flattened; yellow with brownish red cheek; stalk very short; flesh firm, crisp, juicy, and with very rich, high flavor. Generally considered the best winter apple in California. (See table.)

CRAB APPLES.

Though most of the improved varieties of crab apple have been introduced and are grown to a small extent in California, the sorts which have been most generally distributed are the following:—

HYSLOP.—Fruit large, growing in clusters; roundish ovate, dark rich red, covered with thick blue bloom; stalk long, slender; calyx closed; flesh yellowish.

LARGE RED SIBERIAN.—Roundish ovate with large and prominent calyx; pale red and yellow skin.

LARGE YELLOW SIBERIAN.—Fruit similar in size to foregoing, roundish oval, flattened at base and crown; light clear yellow, inclining to amber, with warm cheek.

TRANSCENDANT.—Medium to large, roundish oval, flattened at the ends, slightly but regularly ribbed; golden yellow, with rich, crimson cheek, or nearly covered with red; delicate white bloom; stalk long and slender, in open, deep cavity; calyx closed; flesh creamy yellow.

MONTREAL BEAUTY.—Large, roundish oblate; bright yellow, mostly covered and shaded with red; one of the most beautiful of crabs.

WHITNEY'S CRAB.—Large, handsome, greenish yellow, striped with crimson.

CALIFORNIA SEEDLING APPLES.

SKINNER'S SEEDLING. (Name approved by California State Horticultural Society, November, 1887.) Syn. *Skinner's Pippin; Santa Clara King.*—Originated with Judge H. C. Skinner, on bank of Coyote, east of San Jose, and tree reported still standing in 1879. Recommended by B. S. Fox at Convention of Fruit-growers held in San Francisco, September 8, 1859, and adopted for trial. Described by Committee of New Fruits American Pomological Society 1877 (p. 46) as follows:—

"Santa Clara King: Fruit large to very large; form, oblate, conic, slightly mixed; color rich lemon yellow, faintly striped with bright red; flesh, yellowish white, very tender, juicy, sprightly, mild subacid; quality best. Season, September and October. This is the best very large apple we have seen. Said to be a good grower and productive."

Recommended by Southern California Nurserymen's Association for family use in 1886. (See table.)

MARSHALL'S RED. (Name approved by California State Horticultural Society, November, 1887.) Syn. *Red Bellflower, Marshall's Seedling.*—Originated with J. L. Marshall, Brown's Valley, near Napa, from seeds of Yellow Bellflower, the branches of which interlaced with those of a Red June tree, and the seedling is presumably a chance hybrid between these two varieties. Fruited first about 1877, and generally introduced by Leonard Coates in 1884. The tree resembles Red June in habit of growth; fruit large, same shape as Yellow Bellflower, but of same color as Red June; quality very good; flesh firm and fine-grained; aromatic, and slightly more acid than the Yellow Bellflower; tree, a very heavy bearer, and the fruit ripens in October in the bay region.

VIOLET.—Originated with J. W. Violet, of Ione. One of the largest apples known, averaging nearly as large as Gloria Mundi; conical shape, a beautiful red nearly all over; solid, firm and crisp, good flavor, fine shipper—September to January. Tree strong grower, with upright habit; bark on new wood smooth, glossy and light chestnut color; leaves quite peculiar—a rich, glossy green.—W. R. Strong & Co.

MERKELEY'S RED.—Originated on farm of R. W. Merkeley, near Sacramento. Fruit large size, dark red, excellent flavor, crisp and juicy—a superior market variety. —W. R. Strong & Co.

LUCY'S RED CHEEK.—A fall apple originating with Joseph Sexton, Goleta, Santa Barbara County; fruit medium; roundish, somewhat flattened; skin with a ground of pale, greenish yellow mixed with faint streaks of pale red on shady side, with a bright red cheek; calyx small and set in shallow, rather narrow basin; flesh white, tender, juicy, with a slight perfume.

SEXTON'S GOLDEN SEEDLING.—Originated with Joseph Sexton, of Goleta. Large, roundish, flattened; golden color with a little blush on one side; thin skin and full eye; stem strong in medium cavity; flesh inclined to be buttery, and a sprightly acid flavor; fine table or cooking apple; a fall apple. "The handsomest apple I raise, good size, good bearer; ripe in September, exceedingly tart, and one of the best cooking apples I ever saw."—S. P. Snow, Santa Barbara. "Better than any old kinds of its season, August to October."—G. W. Coffin, Santa Barbara. "A superior August apple and good till October."—R. Machin, Lompoc.

CALISTOGA.—An apple sent to be named by the State Horticultural Society by Samuel Kellett, in March, 1883. Said to have been found in a garden in Calistoga. Pronounced by a committee to be well worth preserving; fine color, flavor, and a good keeper. No fuller description is given. Apple named "Calistoga." At Horticultural Society meeting, November, 1887, W. W. Smith said he had kept the Calistoga until June, and considered it valuable on this account, if for no other reason.

BEAUTY OF ALAMEDA.—(Named by California State Horticultural Society, December, 1882.) A red apple shown by the late W. H. Jessup, of Haywards. Tree from seed planted by W. C. Blackwood. Color deep red, shape like Bellflower, and averaging about the same size; very firm, mild acid, rich.

CLYMAN'S PIPPIN.—Originated in Green Valley, Sonoma County, from seed brought from Oregon by Lancaster Clyman early in the fifties. He fruited a large lot of seedlings and two of them were propagated and distributed by W. H. Pepper, of Petaluma, and others. These two were shown at the first county fair in Santa Rosa some years ago, and one was named Clyman's Pippin and the other Clyman's Russet, although it showed no russet except a little at the stem. Mr. Pepper has the latter in bearing and calls it the "Clyman." In the upper part of Santa Rosa Valley they are growing as the Clyman Pippin the one known in Mr. Pepper's neighborhood as "Clyman's Russet," or the "Clyman." This matter should be straightened out.

COOK'S SEEDLING. (Name approved by California State Horticultural Society, November, 1887.) Syn. *Sonoma Seedling.*—Brought to notice by O. B. Shaw, of

Sonoma, who sent specimens to the *Rural Press* in January, 1872. Described in that paper, January 27, as a seedling raised by David Cook from the seed of the Juneating. Above medium size, pale yellow striped with red, sharp acid flavor. Not decidedly rich, but flavor full and acceptable. Excellent keeping qualities. Especially popular in Sonoma and Napa Counties; reported unfavorably from Placer County.

EXCELSIOR.—Originated with O. N. Cadwell, of Carpenteria, Santa Barbara County. Shown at Los Angeles Horticultural Fair, 1879. Pale yellow in the shade and in the sun wholly red, light red streaked with claret; four inches in horizontal diameter; oblate, base and apex deeply depressed; flavor good, fine for table and dries well; core very small; ripens in October and keeps till December.

ACME.—Originated with O. N. Cadwell; large, oblong, tapering like the Yellow Bellflower; dark red, skin rather unhandsome; flesh very tender and juicy; flavor peculiar, but pleasant; ripens in October and keeps till last of November.

ESOPUS SPITZENBURG SEEDLING.—At the meeting of the State Horticultural Society, April 3, 1880; Milton Thomas, of Los Angeles, showed a seedling from the Esopus Spitzenburg which he found a heavy bearer and excellent keeping apple. Described by Mr. Thomas (September, 1888); rather small, dark but bright red; not quite as large as Jonathan, but a much better keeper; keeping until February; quality good.

WALSH'S SEEDLING.—Found in garden of Mr. Walsh, of Aptos, Santa Cruz County; propagated by James Waters, of Watsonville, who considers it a seedling of Yellow Bellflower from the resemblance of the fruit, and he reports the bark of the young growth the same as that variety, but the manner of growth of the tree is different and the fruit keeps a month longer than the Bellflower. Fruit shown at the Chico Convention of 1888 was reported on by a committee consisting of John Rock, C. W. Reed, and B. G. Stabler, as follows: "We find the apple of the Bellflower type rather broader at the base, but not so much elongated, resembling that well-known variety, except that the acidity, in the specimens shown, is somewhat less marked."

TABULAR SHOWING OF ADAPTATIONS.

Upon the two following pages will be given tabular statements of varieties of apples which are approved by growers in the several counties of the State. The data has been collected by the writer from personal observation and statements made by growers during a long series of years. Some additions have also been made on the authority of recent reports to the State Board of Horticulture, these reports having been kindly submitted to the writer by Mr. Lelong. The plan of the table is to mark with an asterisk (*) the counties in which certain varieties have been reported valuable. It is the writer's design to introduce in later editions, if possible, negative marks where certain varieties are found undesirable. But this work cannot be attempted at this time. In its present form the table merely shows where certain varieties have been actually tried and approved.

The arrangement of the counties is devised to bring those of similar local climates as near together as possible, and the main divisions of the State, as indicated in Chapter I, are observed. These notes apply also to the tabular statements, which will be found in the following chapters on other fruits.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS NAMING VARIETIES OF SUMMER AND FALL APPLES CONSIDERED MOST SATISFACTORY IN THE COUNTIES INDICATED.

COUNTIES OF CALIFORNIA.	Car. Red June.	Early Harvest.	Early Straw'b'y.	Summer Queen.	Red Astracan.	Gravenstein.	Porter.	Golden Sweet.	Maiden's Blush.	Holland Pippin.	Alexander.	Skinner's Seed'g	Fall Pippin.	Golden Russet.	Nonsuch.	Twenty Ounce.	Gloria Mundi.	Fameuse.	King of T. C.	Rambo.
Del Norte	.	*	.	.	.	*	.	.	.	*	.	.	*	.	.	.	.	.	.	.
Humboldt	.	*	*	.	*	*	.	.	.	.	.	.	*	*	.	.	.	.	*	.
Mendocino	*	*	.	.	*	*	*	.	*	.	.	.	*	.	.	.	*	.	.	*
Lake	*	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.
Napa	*	*	.	.	*	*	.	.	.	.	.	.	*	.	.	.	.	.	*	.
Sonoma	*	*	.	.	*	*	.	.	.	*	.	.	*	.	.	*	.	.	*	*
Marin	.	*	.	.	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Contra Costa	.	*	.	.	*	*	.	.	.	*	.	.	*	.	.	.	.	.	*	.
Alameda	*	*	*	*	*	*	.	.	.	*	*	*	*	.	*	.	*	.	*	.
Santa Clara	*	.	.	.	*	*	.	*	*	.	*	*	*	.	*	*	*	.	.	.
San Mateo	*	*	*	.	*	*	.	*	.	.	.	.	.	.	.	.	.	.	*	.
Santa Cruz	*	.	.	.	*	*	.	.	*	.	*	.	*	.	*	*	*	.	*	*
San Benito	*	.	.	.	*	*	.	.	*	.	.	.	*	.	*	*	*	.	*	.
Monterey	.	*	.	.	*	*	.	*	.	.	.	*	*	.	*	*	*	.	*	*
San Luis Obispo	.	*	.	.	.	.	.	.	.	.	.	.	.	*	.	*	.	.	.	.
Santa Barbara	*	*	*	.	*	*	.	.	*	.	.	*	*	*	.	.	.	.	*	.
Ventura	*	*	.	.	*	*	.	.	.	.	.	*	*	*	.	.	.	.	*	.
Los Angeles	*	*	*	.	*	*	.	.	*	.	.	*	*	.	.	.	.	.	*	.
San Diego	.	*	.	.	*	*	.	.	.	.	.	*	*	.	.	.	.	.	*	.
San Bernardino	*	*	.	.	*	*	.	.	*	.	.	.	.	.	.	.	*	.	.	.
Kern	.	.	.	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tulare	*	*	.	.	*	.	*	.	*	.	.	.	.	.	.	.	.	.	*	.
Fresno	.	*	.	.	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merced	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.
Stanislaus†	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
San Joaquin	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sacramento	*	*	.	.	*	*	.	.	*	.	.	.	*	*	.	.	.	.	.	.
Solano	*	*	*	.	*	*	.	.	.	.	.	.	*	*	.	*	.	.	*	.
Yolo	*	*	.	*	*	*	.	.	.	.	.	.	.	.	.	.	.	.	*	.
Sutter	.	.	.	.	*	*	.	.	.	.	*	.	.	.	.	.	.	.	.	.
Yuba	.	.	.	.	*	*	.	.	.	.	.	*	*	.	.	.	.	.	.	.
Butte	*	*	.	.	*	*	*	*	.	.	.	.	*	.	.	.	.	.	.	.
Colusa	*	.	.	.	*	*	*	.	.	.	.	.	*	.	.	.	.	.	.	.
Tehama	*	*	.	.	*	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.
Shasta	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.	.	.	.
Trinity	.	*	.	.	*	*	.	*	.	.	.	.	.	.	.	.	.	.	.	*
Siskiyou	*	*	*	.	*	*	.	*	.	.	.	.	*	.	.	.	.	.	.	*
Modoc	*	*	*	.	*	*	*	*	.	.	.	.	*	*	.	.	.	.	.	*
Lassen†	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plumas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sierra	.	*	*	.	*	*	.	.	.	.	.	.	*	.	.	.	*	.	.	.
Nevada	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Placer	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
El Dorado	*	.	*	.	*	*	*	.	.	.	*	*	*	.	.	.	.	*	.	.
Amador	*	*	*	*	*	*	*	.	.	*	*	*	*	.	.	.	.	.	.	.
Calaveras	*	*	*	*	*	*	.	.	.	.	*	*	*	.	.	*	*	.	.	.
Tuolumne	.	.	.	.	*	*	*	*	.	.	.	*	.	.	*	.	.	.	.	.
Mariposa	*	*	*	.	*	*	.	.	.	.	.	.	*	.	.	.	.	.	.	*
Alpine†	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mono	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inyo	*	*	.	.	*	.	.	.	.	.	*	*	*	.	.	.	.	.	.	.

† No data.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS NAMING VARIETIES OF LATE FALL AND WINTER APPLES CONSIDERED MOST SATISFACTORY IN THE COUNTIES INDICATED.

COUNTIES OF CALIFORNIA.	Roxbury Russet.	Ben Davis.....	Baldwin.....	Hoover.....	R. I. Greening.	Vandevere.....	Jonathan.....	Winesap.....	Swaar.....	Yel. Bellflower.	Romanite.....	Esopus Spitz...	Smith's Cider...	Nickajack.....	Northern Spy...	R.W. Pearmain.	W W. Pearmain	Rawles Janet...	Wagener.....	Yel. N. Pippin.
Del Norte	*	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*
Humboldt	.	.	*	.	*	*	*	*	.	*	.	.	.	.	*	.	.	.	.	*
Mendocino	.	.	*	.	*	*	*	*	*	*	.	.	.	.	.	.	.	.	*	*
Lake.	.	.	*	*	*	*	.	*	.	*	.	*	.	.	.	.	.	.	.	*
Napa	.	*	*	*	*	*	*	*	.	*	.	*	*	*	.	*	*	.	.	*
Sonoma	*	*	*	*	*	*	*	*	*	*	.	*	*	.	*	*	*	.	*	*
Marin	.	.	.	.	*	*	.	*	.	*	.	*	*	.	*	*	*	.	.	*
Contra Costa	.	*	*	.	*	*	*	*	.	*	.	*	*	*	.	*	*	*	.	*
Alameda	*	.	*	.	*	*	*	*	*	*	.	*	*	*	.	*	*	.	.	*
Santa Clara	.	.	*	*	.	*	*	*	.	*	.	*	*	.	.	*	*	.	.	*
San Mateo	.	.	*	.	.	*	*	*	.	*	.	*	*	.	.	*	*	.	.	*
Santa Cruz	.	.	*	*	*	*	*	*	.	*	.	*	*	.	.	*	*	.	.	*
San Benito	*	.	*	.	.	*	.	*	*	*	.	*	*	.	*	*	*	.	.	*
Monterey	.	.	.	.	*	.	*	*	.	*	.	*	*	.	*	*	*	.	.	*
San Luis Obispo	*	.	.	.	.	*	*	*	.	*	.	.	*	*	.	*	*	.	.	*
Santa Barbara	*	*	.	.	*	*	*	*	.	*	.	.	*	*	.	*	*	.	.	*
Ventura	.	*	.	.	*	*	*	*	.	*	.	.	*	*	.	*	*	.	.	*
Los Angeles	.	*	.	.	*	*	*	*	*	*	.	*	*	*	.	*	*	.	.	*
San Diego	*	*	.	.	*	*	*	*	.	*	*	.	*	*	.	*	*	.	.	*
San Bernardino	.	*	.	.	*	.	.	*	.	*	.	.	.	.	.	*	*	.	.	*
Kern	.	.	.	.	.	.	.	.	.	*	*	.	*	.	.	*	*	.	.	*
Tulare	.	*	.	.	*	*	.	*	.	*	*	*	*	.	*	*	*	*	*	*
Fresno	.	*	.	.	.	.	.	.	*	*	*	*	.	.	.	*	*	*	.	*
Merced	.	.	*	.	*	*	.	*	.	*	*	.	*	.	.	*	*	*	.	*
Stanislaus†	.	.	.	.	.	.	.	*	.	*	.	.	.	.	.	.	.	.	.	.
San Joaquin	.	.	*	.	*	.	.	*	.	*	.	*	.	.	.	.	.	.	*	*
Sacramento	*	.	*	.	*	.	.	*	.	*	*	.	.	*	.	*	*	.	*	*
Solano	.	.	*	.	*	.	.	*	.	*	*	.	.	.	.	*	*	.	.	*
Yolo	.	.	.	.	.	*	.	*	.	*	*	*	.	.	.	.	.	.	.	*
Sutter	.	.	.	.	.	.	*	*	.	*	*	.	.	.	.	.	.	.	.	*
Yuba	.	*	*	.	*	*	.	*	.	*	*	.	.	.	.	.	.	.	.	*
Butte	*	*	*	.	*	*	.	*	.	*	*	*	*	.	*	*	*	*	.	*
Colusa	.	.	.	.	*	*	.	.	.	*	*	*	.	.	.	.	.	.	.	*
Tehama	.	.	.	.	.	.	.	*	.	*	*	*	.	.	.	.	.	.	.	*
Shasta	.	.	.	.	.	.	.	*	.	*	*	*	.	.	*	.	.	*	.	*
Trinity	*	*	*	.	*	.	.	*	.	*	*	*	*	.	*	.	.	*	.	*
Siskiyou	.	.	.	.	.	*	.	*	*	*	*	*	.	.	.	*	.	.	.	*
Modoc	.	.	.	.	.	.	*	.	.	*	.	.	.	.	.	*	.	.	.	.
Lassen†	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plumas	.	*	*	.	*	.	.	*	.	.	.	*	*	.	.	.	.	.	.	*
Sierra	.	.	*	*	.	.	.	.	.	*	*	.	.	.	.	*	*	.	.	.
Nevada	.	.	*	.	*	.	.	.	.	*	*	.	.	.	.	.	.	.	.	.
Placer	.	.	*	.	.	*	.	.	.	*	*	*	*	.	.	.	.	.	.	*
El Dorado	*	.	*	.	*	*	*	*	*	*	*	*	*	.	.	.	.	.	.	*
Amador	*	.	*	.	*	*	*	*	*	*	*	*	*	.	*	*	.	.	.	*
Calaveras	.	.	*	.	*	*	*	*	*	*	*	*	*	.	*	*	.	.	.	*
Tuolumne	*	.	*	.	*	*	*	*	.	*	.	*	.	.	*	*	.	.	.	*
Mariposa	.	*	*	.	.	*	*	*	.	*	.	*	.	.	.	*	.	.	.	*
Alpine †	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mono	.	.	.	.	.	*	.	.	.	.	.	*	.	.	.	.	.	.	.	.
Inyo	.	*	.	.	*	*	.	*	.	*	*	*	.	.	*	.	.	.	*	*

† No data.

CHAPTER XVII.

THE APRICOT.

CALIFORNIA has peculiar adaptations for the growth of the apricot. It has often been pointed out that such adaptations are exceptional, and that nowhere else does the fruit attain such perfection nor possess such commercial importance. Although the apricot has been grown here from the earliest days of the American occupation, and though since the opening of the export trade in canned and dried fruits, the planting of apricot orchards has proceeded with great rapidity, present indications are that our distant patrons are only just beginning to recognize the desirability of the fruit, and that their demands will make it well-nigh impossible for us to extend our production beyond profitable limits.

Though the apricot has some pests and diseases to contend with, they have thus far proved slight evils, and the tree is generally regarded as one of our healthiest and most vigorous, as it certainly is one of our most beautiful, orchard trees. It is long-lived and attains great size. There is on the ranch of F. Hubert, near Burson, in Calaveras County, a seedling apricot tree planted March 10, 1857, which now has a trunk seven and one-half feet in circumference, and has yielded one thousand five hundred pounds of fruit of good quality in a season. At Haywards, Alameda County, Judge Blackwood has apricots worked on peach stock in 1857, which are still in good bearing. His observation is that the apricot gives longevity to the peach root, for the peach trees of the same age not worked with apricot have disappeared. But thirty years of life and vigor is only a part of the career of the apricot in California, if it is fair to judge by the vigor of trees in New Mexico which were found growing there by the early trappers and frontiersmen, and were, apparently, old trees fifty years ago.

The apricot is a rapid grower and an early and heavy bearer in California. In the interior and in the southern coast valleys it yields a paying crop during its third summer in the orchard, and from eight to fourteen tons to the acre has been reached for several years in succession, in Judge Blackwood's old orchard of Royal apricots, in Alameda County.

The trees, even of some varieties which are uncertain bearers, are large and vigorous growers. Professor C. H. Dwinelle makes the pertinent suggestion that there is a use for the apricot tree which many have not discovered, that is, for a wind-break for the protection of other trees. The peach shrinks away from the trade-winds, but the apricot leans a little toward them, and is thickest in foliage on that side. The trees may be planted near together in strong land and make a wind-break that will pay its way without regard to such fruit as it may incidentally produce.

LOCALITIES FOR THE APRICOT.

In speaking of localities for the apricot, reference is, of course, only made to its growth as a standard orchard tree without protection of any kind. It shows even in California that it does not forget the conditions which destroy its thrift elsewhere, for late frosts in our three upper coast counties, Mendocino, Humboldt, and Del Norte, render it, as a rule, unprofitable; and Lake County, just back from the coast, cannot be commended for the apricot, except in protected situations. It is also sensitive to too great elevation on the foot-hills of the Sierra Nevada, though it thrives in the lower foot-hills. In the depressions of the great interior valleys young trees sometimes suffer, unless given some protection, while older ones are unharmed. In the northern coast valleys, apricots usually do better on the hillsides than on the floors of the valleys, because there is less frost at the slight elevations.

It is often claimed that situations directly subject to ocean influences are best for the apricot. It is noted by many observers that the apricot "points its best branches to the ocean, in the very teeth of the constant breeze, and the landward limbs and twigs bend up and endeavor to reach in the same direction. This is patent in every tree, and in the long orchard rows is very striking."* This is taken to signify the special liking of the tree for the vicinity of the coast. It is well enough to interpret it that way, providing one does not lose sight of the perfect success of the apricot in the interior as well. It is true that the fruit near the coast attains higher color, and the less rapid growth of the tree makes it somewhat easier to handle, but the earlier ripening in the interior, coupled with freedom from fog and constant sunshine for drying, which enable the grower in favorable situations to dispense with machine driers, are points of the highest industrial importance. The fact is that the apricot has a very wide range in California, and though the trees have been cut

*S. R. Thorpe, of San Buena Ventura.

out at some points it has been chiefly because they do no thrive under the summer irrigation system which has been practiced, or because some other fruit has seemed to be locally more desirable, for one reason or another.

In some valleys in the upper part of the State, opening directly to the ocean, there is sometimes complaint of the cracking of the fruit on the sunny side. The alternation of sunshine and fog seems to have something to do with this, for in favorable years, when fogs are few, the fruit is sound.

Locations for early ripening of the apricot are to be chosen with reference to the influence of topography, as laid down in the chapter on that subject. In a general way it may be said, in regions directly subject to coast influences, both in Northern and Southern California, the apricot is late. On the west side of the Sacramento Valley, in small, hill-locked valleys, the earliest apricots have been grown for years, and recent experience indicates that protected situations in the foot-hills of the Sierra Nevada, on the eastern rim of both the Sacramento and San Joaquin Valleys, share in the production of the earliest ripening fruit. There is much yet to be determined on this subject. There is, probably, about a month's difference in the ripening of the same variety in the earliest interior situations and in the coast valleys of both Northern and Southern California.

In the interior of Southern California, in irrigated situations, on the so-called Colorado Desert, and in Arizona, apricots promise to rival in earliness the famous valleys of interior Northern California.

STOCKS AND SOILS FOR THE APRICOT.

Because of the success with which the apricot can be budded on various stocks, it has a wide range in adaptation to different soils. Budded on the peach root it may be grown successfully on the light, warm, well-drained loams in which the peach delights. The peach root is, in fact, largely used for the apricot. It gives the tree quick growth and early fruiting, and the fact that the gopher does not like the peach root is a consideration with some planters. In growing stock, pits of a strong-growing, yellow peach should be secured.

For deep, rich, well-drained, loamy soils, the apricot on its own root makes a magnificent tree. Apricot roots for budding are easily secured. The pits sprout as readily as corn. Dr. Kimball, of Haywards, an experienced tree propagator, recommends especially pits of the Royal, Blenheim, and Early Golden, for growing stocks for budding. Sometimes, where cutting and drying are done in the orchard, the ground the next spring will be

almost covered with a volunteer crop of seedling apricots. These little plants taken up and set out in nursery rows in March are ready for budding in June or July. Large numbers of trees are sometimes secured in this way. In the upper San Joaquin Valley there are situations in which the apricot seems more productive on its own roots than on the peach.

When it is desired to grow the apricot in moister and heavier soils than have been described, or where a light soil is underlaid by a heavy, retentive subsoil, recourse should be had to the plum root. Only a non-suckering plum stock should be used. For this purpose the myrabolan has been considerably used of late, W. H. Pepper, of Petaluma, employing this stock almost exclusively. Some growers complain that the root has a dwarfing effect on the tree, and object to its use. The manner of securing myrabolan stocks has been described in the chapter on propagation.

APRICOT ON ALMOND.—The almond should as a rule be rejected as a stock for the apricot. Hundreds have tried it, and found that the scion never made a good union with the wood of the stock, but was knit to it only by the bark, and is, therefore, easily broken off by the wind. It may grow well and sometimes get to be two or three inches in diameter before it breaks off, thus wasting much time for the orchardist. Whole orchards worked in this way have been a loss and disappointment.

A few growers, however, approve the almond and use it with the idea that it gives larger fruit. J. J. Shaner, of Los Gatos, advocates the almond stock for the Royal apricot in dry soils and thinks that the failure to form a union of the two woods in the experience of others may have resulted from too close suckering of the stock. He proceeds, however, by root grafting, instead of budding, using the side graft described on page 121. He cuts off the top of the stock about four to six inches above ground, scrapes away the dirt, bends the stock, and, with a sharp, thin knife, cuts into the root to the center, making the cut perpendicular, so that the graft will be that way when inserted. The scion should be made wedge-shaped. After insertion draw the loose earth around it, and the work is done until the graft has made a growth of eighteen to twenty-four inches, then sucker; but if the suckers have hardened, a knife or shears must be used. By doing this, he says the union will not be broken. Mr. Shaner grows the Moorpark on the apricot root and the Royal on the almond root. The former always grows large fruit; the latter, he believes, is improved in size by the almond stock. This is given as a record of experience, but still caution is urged against the use of the almond as stock for the apricot.

In addition to the specifications of certain stocks for different soils, it may be remarked, in a general way, that the apricot seems to thrive better on a tolerably heavy soil, with enough sand to make it work easily, than on a very light soil. It does well on soil rather too heavy for the peach. It also enjoys moisture better and gives signs of distress unless its roots are fairly supplied all during the season, but it dislikes standing water and should not be planted on undrained situations.

EXPOSURES FOR THE APRICOT.

The apricot blooms early; it follows the lead of the almond. Thus it runs greater risk than other fruits of frost injuries during blooming. And in the parts of the State most subject to frost, exposures should be selected in accordance with the principles laid down in Chapter I, which treats of topography as related to fruit growing.

In securing the advantage of the earliest ripening even in the earliest districts, elevation is of great importance. The first apricots of the season for a number of years have come from an elevated ridge, rising in the center of Pleasant's Valley, in Solano County. This ridge has higher hills but a short distance away on both east and west, which protect it from cold winds, and on all sides there is low ground, to which cold air can freely descend. In this spot apricots and other fruits ripen several days earlier than on other lands but little removed.

PLANTING THE APRICOT.

The apricot becomes a large tree in California, as has already been remarked, and the deduction which most growers are drawing from their experience is that it should be given plenty of room. Joseph Sexton, of Santa Barbara, says:—

> Apricots should be planted in orchards not closer than 25x25 feet. They will then touch in about twelve years, if planted in good land, and if on poor land it is better to give them plenty of room, for they will not stand crowding as well as on good land. I have one tree of fourteen years' growth from the bud that measures thirteen inches in diameter of body one foot from the ground, and the top spreads thirty-eight feet. It is on good valley land. The apricot is next to the walnut in growth, and we may find, when better acquainted with it, that we should give the tree as much room as we are giving the walnut, 40x40 feet.

This statement agrees well with the general experience of our apricot growers. The tendency is continually toward wider planting. Mr. A. T. Hatch has made his later plantings thirty feet each way.

The apricot makes such rapid growth and so much depends upon giving it proper form, as will be seen presently, that one year's growth is all that should be allowed in the nursery. Some

growers would rather have a dormant bud than a two-year-old tree, and cases have been reported of trees from dormant buds outgrowing yearling trees planted at the same time in the same orchard. Dr. Strentzel says he finds two-year-old peach seedlings budded with the apricot and transplanted early in the season, in dormant bud, preferable to older growth. But care should be taken to develop a short trunk to the tree by pinching the side shoots near the ground. Trees started from dormant bud and allowed to branch from the ground, have, in some situations, lost their lower branches by the wind. The tree should have a low head, but a short trunk seems to give a better tree, and more elasticity to the branches.

PRUNING THE APRICOT.

Of all California orchard trees, the apricot seems most in need of the constant attention of the orchardist to give it proper shape and strength. It is a rampant grower, and in its zealous haste for size and fruitage it overreaches itself and becomes the prey of specific gravity and wind force. Thousands of trees have been ruined by literally breaking to pieces with the weight of their fruit, and being torn by winds of only ordinary velocity. Thousands more have been rescued from such a fate by bolting the branches to each other, as described in Chapter XII, on pruning. This excessive growth and consequent weakness of the apricot is greater in some parts of the State than in others, because of the difference in degree of forcing conditions, but everywhere the apricot needs watchfulness and timely aid in building up its strength. The general principles to be observed may be briefly summarized, and then the methods of securing them by practical growers in different parts of the State will be given:—

First—Low heading of the apricot and oblique upward trend of the main branches must be secured, for the reasons given in the chapter on pruning. The engraving on the following page, of six-year-old apricots in bloom in Vaca Valley, shows the general form of tree indicated.

Second—The prevention of forks, and giving each branch a clear hold of its own on the trunk by bringing them out at different points up and down and balancing them around the trunk, is indispensable. For this reason it is a mistake to allow all the branches to emerge near together at the top of the stem. This has been mentioned in a general way in the chapter on pruning, and is repeated here to emphasize the special importance in reference to this fruit.

Third—Remember that the growth of lateral branches causes greater deposit of woody fiber along the main branch or stem, and consequently greater inherent strength. Therefore, do not rub off shoots which are putting out along the stem or main branches, but rather pinch off the ends of those which are not

SIX-YEAR-OLD APRICOT TREES IN BLOOM, BUCK'S ORCHARD, VACA VALLEY.

desired to grow. This pinching will have to be done several times during the summer. The tufts of leaves will shade the stem and will secure the thickening which is desirable.

Fourth—Shortening in or cutting back is essential to securing sustaining strength to the apricot. This must be done wherever the apricot is grown in this State, but the measure of the treatment varies according to local conditions. In some parts cutting back in the winter is relied upon; in others, both

summer and winter "shortening in" are practiced, though there seems now to be a disposition to restrict heavy cutting to the winter pruning.

METHODS OF LEADING GROWERS.

The following is the method followed by W. W. Smith, of Vaca Valley, and described by him in an essay before the California State Horticultural Society:—

The apricot is somewhat peculiar in its mode of bearing fruit; like the peach, it bears on wood of last year's growth, and like the plum, it also bears on small fruit spurs of two or more years' growth. Then, again, it is very peculiar in its manner of growth: each summer's growth is furnished nearly throughout its entire length with small side shoots, or laterals. This is different from other fruit trees. In pruning we recommend the annual shortening-in system; that is, this winter cut away one-half or two-thirds, according to the amount of growth the trees make, of last summer's growth. But after the branches have been cut off, there will still remain the small laterals; these should also be cut back, say to a length of two to four inches. They will thus be converted into fruit spurs, and a saving of one or two years' time in the bearing of the tree is gained, for the crop on the one-year-old wood cannot be relied on, but the main yield will come upon the small spurs in the interior of the tree. Hence the advantage of the annual shortening-in system; it keeps those spurs in a healthy condition. Trees trained in the shape of a vase or goblet and cut back every winter will remain in a healthy, vigorous condition for a long time.

RETAINING A CENTRAL STEM.—The following method, described by J. A. Schoelfield, of Hollister, San Benito County,* builds the tree upon a central stem or leader:—

The apricot is a vigorous grower and apt to overbear, hence it must be cut back heavily, at least for the first three years, in order that the wood may become strong and the tree stocky, that it may successfully withstand the wind and hold the subsequent crops without breaking down. I would recommend upon planting to cut the tree back to about fourteen to eighteen inches in height, removing all laterals. During the first year of the tree's life in the orchard, it will throw out numerous shoots, which are to be removed at the first pruning, leaving three or four of the most vigorous, being careful to select those at a distance from each other, rather than those around the crown, which, if left, have a tendency to break down or split the tree. Cut these back to about one foot in length, leaving the center or leader from six to eight inches longer than the rest, and leaving the terminal bud toward the center, and the terminal bud on the leader on the side from which it leans. This is done that the tree may always stand on its own center. The second year the tree will grow more vigorous than the first, hence it becomes necessary to pinch off the ends of the shoots in order to harden the wood, and cause the trees to throw out some fruit spurs. This is done in August and September. The second pruning is more complicated than the first. Remove all outside branches having a low tendency, as they interfere with cultivation and are liable to break when full of fruit, leaving a gap in the tree which is not easily filled, thus destroying the symmetry of the tree. Thin out well the center of the tree and cut back to about fourteen or sixteen inches again, leaving leader longer than the rest, and leaving terminal buds same as before. So the tree is treated every year, the great object being to make a strong, handsome tree, the branches far enough apart to prevent rubbing or growing one across the other. I am a firm believer in summer pruning, always cutting off all superfluous growth (water sprouts), which are only a drain upon the tree, and if removed cause the sap to flow where it is needed. Always remove all weak or unhealthy fruit spurs.

* Hollister *Free Lance*, February 17, 1888.

SUMMER AND WINTER PRUNING.—The following, in which J. H. Harding, of Fresno,* describes his practice, may be taken to represent the most vigorous system of pruning practiced in this State, as it employs two well-defined "shortenings in," one in the summer and the other in the winter:—

I watch my trees the first season after planting, and as soon as they have grown three feet cut back to eight or ten inches. This causes the sap to fill up every pore in the body and limbs of the tree preparatory to pushing out a new growth of side limbs, or laterals, on the new wood you have left, and this stiffens up the whole stock, and also helps to make the junction of old and new wood more solid, neither can the winds whip and bend your young tree about and split off limbs. Soon after you have cut away this new growth you will see young shoots starting out all over the tree, and if, when they have made a similar growth, the head of your tree is not thick enough, or seems top-heavy and weaves about, cut back again and don't be afraid of hurting it, but get your tree stocky. With all the care and deep cultivation necessary, your tree should make a fine growth and be well shaped the first year. Then in the following winter prune out all weak branches, cross limbs, and cut back the ends of all limbs to good, sound, well-matured wood. Follow up the same treatment second and third years, and never allow your tree to run out long limbs and sprawl about, always keeping the head well balanced, and, where exposed, the heaviest side to the wind. The apricot, as we all know, for the first few years is a wonderful grower, and must be kept in subjection, or it will, in this valley especially, run away with itself and go to pieces sure.

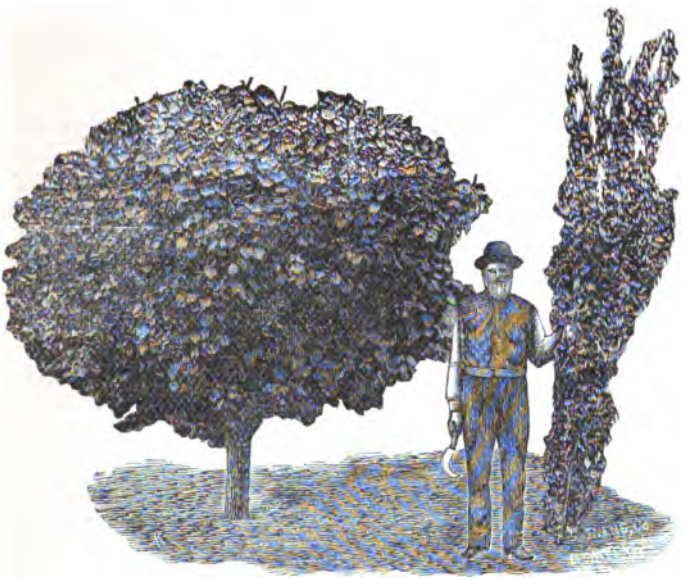
Where this summer shortening is practiced, it is important that it should be done early in the summer, for instance, just after the fruit is gathered, so that the second growth of wood which is forced out may have time to harden. But where summer pruning is done to develop fruit buds, it is well not to do it too early, because wood growth is not desired. It is usually done at the first spare time after the general fruit crop is cared for, and is, therefore, sometimes deferred as late as the first part of October, but is usually accomplished in the latter part of August and September. Shortening in both summer and winter to repress too exuberant growth, and secure good weight-bearing strength in the tree, is the usual practice in Southern California. The engraving shows a tree after its summer pruning, the limb held up by the pruner giving an idea of how great growth is sometimes cut away. The engraving on the next page is from a photograph by E. A. Bonine, of Los Angeles County.

THINNING THE APRICOT.

All free-fruiting varieties of the apricot must be thinned to secure size acceptable to purchasers. It is the experience of the oldest growers that though thinning is an expensive operation, it is very profitable. When half the fruit is taken off in thinning, the remainder reaches as large aggregate weight as though the whole were allowed to mature, and the thinned fruit is worth

*Fresno *Republican*, August 5, 1887.

about twice as much per pound. Even if less weight is secured, and in most cases the purpose should be to get less weight, the tree is spared the exhaustion of overbearing and the owner escapes a year of little or no fruit. Some growers are con-



SUMMER PRUNING THE APRICOT IN SOUTHERN CALIFORNIA.

stantly on the lookout for varieties which set less fruit, distribute it better over the tree, and bear regularly every year. Whether they will attain this ideal of behavior in an apricot tree is not certain, but some sorts seem to promise something in that direction.

DISEASES OF THE APRICOT.

Though the apricot tree, as has been said, is regarded as one of the healthiest fruit trees, it is subject to some maladies. Trees perish from being set in unsuitable situations, and in these cases, if the evil be stagnant water in the soil, or penetration to alkaline subsoil, the root shows it. Sometimes, however, a branch or a whole tree withers and dies without apparent cause early in the summer, and while the root is still sound. The disease is evidently acute, but its cause is not known, nor a remedy proposed. It is an old trouble of the apricot and not peculiar to California.

The so-called "gum disease" sometimes causes injury to trees. The best treatment is to cut away the diseased part

down to healthy wood and cover the wound with a solution of shellac in alcohol. Some growers have reported good results by binding on a plaster of fresh cow manure and mud, equal parts of each. This is applied after scraping away the diseased bark, and it is kept moist for a few days by pouring on a little water.

Some years certain varieties in particular are blackened at the pit and rendered unsalable, but the trouble has not thus far proved serious generally.

The worst injury to tree and fruit is done by what is called the "shot-hole fungus" (*Phyllosticta circumscissa*), from its perforations of the leaves as though by a charge from a shot-gun. It makes ugly scars on the fruit, which render it unsalable. The same disease also affects the leaves of cherries and plums. Dr. Kimball, of Haywards, says that the air-slaked lime thoroughly sprinkled over the tree immediately after the setting of the fruit and bursting forth of the leaves, has proved an effectual remedy.

Until recently the apricot has been considered free from scale insects, and it is not affected by those species which are worse on some other fruit trees. Within the last two years the apricot has been seriously infested in some places with a large, light brown scale, probably a *lecanium*, of which the species has not been determined, of which fuller mention will be made in the chapter on injurious insects.

The ripe apricot is sometimes seriously assailed by the *diabrotica*, a small green beetle, with twelve black spots upon its wing covers. Dusting with air-slaked lime and driving the insects away with smoke smudges have been used to some extent. Fortunately, the insect only occasionally occurs in large numbers.

VARIETIES OF THE APRICOT.

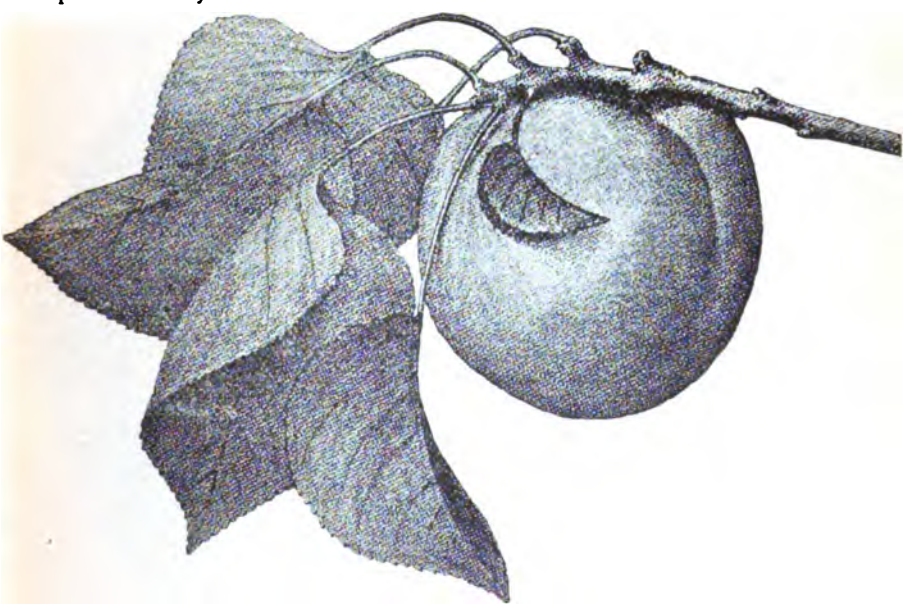
Though nearly all standard varieties of the apricot have been introduced and planted in this State, comparatively few are found on the lists of the orchard planters. Many local seedlings are coming into notice, and probably within the next few years some of them will be widely used. As with most other fruits, some varieties are found to succeed wherever conditions favor the fruit at all; other varieties succeed in some regions and not in others. Our table of varieties for the different counties shows this fact, and an attempt will be made to make the showing more explicit by notes in connection with the mention of each variety. There are, however, differences in localities not far apart which greatly influence the behavior of varieties and make any generalization defective. For example, C. M. Drake, of Springville, Ventura County, in a mountain val-

ley at an elevation of about sixteen hundred feet, planted, in 1884, the Early Golden, Large Early, Hemskirke, Moorpark, Peach, and Royal varieties, which do well in the Santa Clara Valley eight miles from his place. Of these he has so far only had satisfactory returns from the Hemskirke and Royal; the Moorpark and peach have yielded a little, and the Early Golden none.

In the following statement the arrangement is approximately in the order of ripening, and the descriptions are from Downing, with additions and changes to meet local observation:

VARIETIES OF FOREIGN ORIGIN.

LARGE EARLY.—A French variety; fruit of medium size, rather oblong and compressed; suture deep, skin slightly downy; pale orange in the shade, fine bright orange with a few ruddy spots in the sun; flesh separating readily from the stone, orange colored, rich and juicy; kernel bitter. This variety is especially popular in the southern coast counties, but in most situations has proved an uncertain bearer. Ripens before Royal.



BLENHEIM APRICOT, GROWN IN UNIVERSITY ORCHARD.

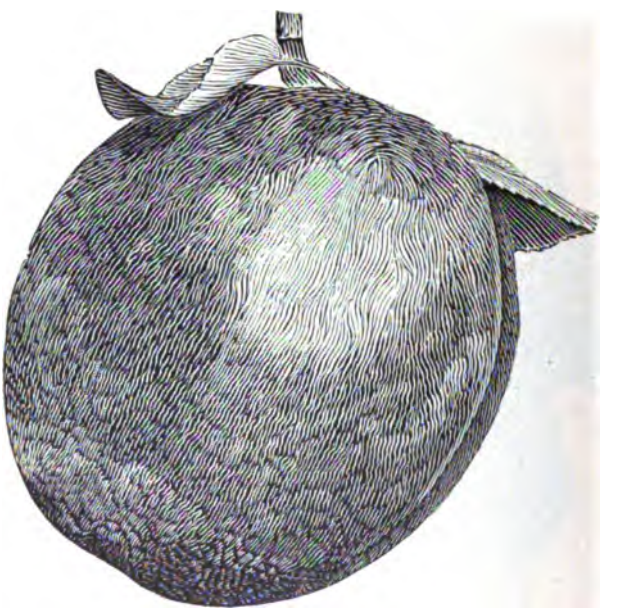
EARLY GOLDEN.—Origin unknown; small, roundish oval, with suture well marked and extending half way around; skin smooth, pale orange; flesh yellow, moderately juicy and sweet, with very good flavor; separates from the stone. This variety is reported favorably from some counties, but generally otherwise, and is not largely grown. Ripens before Royal.

ROYAL.—A French variety, and at the present time the leading California apricot. Of large size (when well thinned out), free stone, fine color and flavor, good bearer, and fruit ripens evenly, when well grown; a favorite with the canners and an

excellent variety for drying. Fruit roundish, large, oval, slightly compressed; skin dull yellow with orange cheek, very faintly tinged with red, and a shallow suture; flesh pale orange, firm and juicy, with a rich vinous flavor. Commended by Southern California Nurserymen's Association.

There is a variety somewhat grown in Sacramento and Solano Counties, sometimes called "White Royal," which is not liked by canners, because of its lack of color and flavor.

BLENHEIM, OR SHIPLEY.—This is a promising variety in this State and seems to surpass Downing's description both in vigor of tree and size of fruit. John Rock modifies Downing's description to suit California experience with this variety as follows: "A very good variety, above medium, oval; orange, with a deep yellow, juicy, and tolerably rich flesh; vigorous grower and regular prolific bearer." This agrees perfectly with the behavior of the variety in the University orchard at Berkeley, where it is the best of twenty varieties. It is not reported so constant a bearer in some other parts of the State. Fruit runs a little larger than the Royal, and is usually better distributed on the tree, but it must be well thinned. This variety has been approved by canners. Ripens a little later than the Royal.



LARGE EARLY MONTGAMET APRICOT.

HEMSKIRKE.—A fine English variety quite widely grown in California; ripens later than Royal, described by Downing as follows: "Fruit large, roundish, but considerably compressed or flattened on its sides; skin orange with red cheek; flesh bright orange, tender, rather more juicy and sprightly than the Moorpark, with rich, luscious, plum-like flavor; stone not perforate, rather small and kernel bitter." Esteemed in California because the tree is more hardy and a more regular bearer than the Moorpark, and the fruit ripens evenly on both sides.

PEACH.—A variety from Piedmont of the largest size, about two inches in diameter, roundish, rather flattened, and somewhat compressed on its sides, with a

well-marked suture; skin yellow in the shade, but deep orange mottled with brown on the sunny side; flesh of a fine yellow, saffron color, juicy, rich, and high-flavored; stone can be penetrated like Moorpark and has bitter kernel. This is a very successful sort in the warmer parts of the State especially, and is a favorite in the Sacramento Valley. It ripens just ahead of the Moorpark.

MOORPARK.—A standard of excellence and an old variety which originated in England. Fruit large, roundish, about two inches and a quarter in diameter each way; rather larger on one side of the suture than the other; skin orange in the shade, but deep orange or brownish red in the sun, marked with numerous dark specks and dots; flesh quite firm, bright orange, parting free from the stone, quite juicy, with a rich and luscious flavor; stone peculiarly perforated along the back, where a pin may be pushed through; kernel bitter. In California the Moorpark reaches grand size, but has the fault of ripening unevenly in most localities. The tree is tender and bears irregularly, which leads to its rejection by most planters, though some growers cling to it because of its size and quality and occasional grand crops. The San Jose districts lead in the production of this variety, and in some parts of the Santa Clara Valley the Moorpark seems to ripen uniformly. The same behavior is reported from localities in the upper San Joaquin Valley, where it also seems to be a more regular bearer. The variety is almost wholly rejected in Southern California.

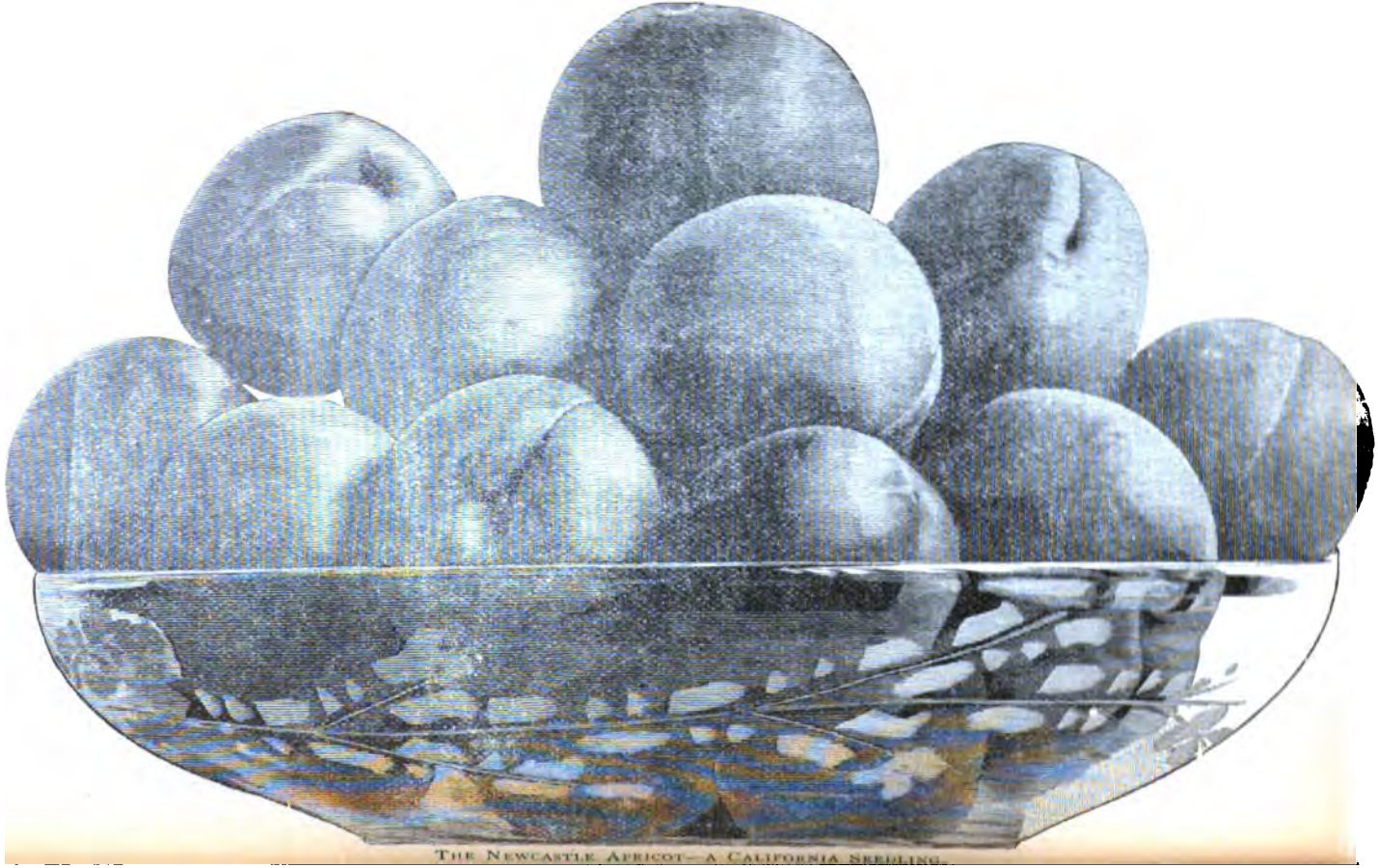
ST. AMBROISE APRICOT.

ROMAN.—Described by Downing as one of the largest growing and hardiest apricot trees, and bearing good crops where few others succeed: "Fruit middle-sized, oblong, with sides slightly compressed, with but little or no suture; skin entirely pale yellow, or very rarely dotted with a few red spots on one side; flesh dull yellow, soft, rather dry; stone oblong with bitter kernel." This variety is pronounced by the Southern California Nurserymen's Association the best apricot for Southern California, and they announce that this is the variety which they have been largely growing under the name Early Moorpark. Ripens a little sooner than Moorpark.

TURKEY.—An old variety of medium size, roundish, not compressed; skin deep yellow in the shade, brownish orange in the sun; flesh firm, juicy, of excellent flavor, inclosing sweet kernel; ripens after Moorpark, and commended by Southern California Nurserymen's Association as good for home use, but too juicy for canning or market.

BREDA.—A small, early apricot of exceptionally good flavor. Only a few California growers speak favorably of its bearing qualities.

NEWLY DISTRIBUTED VARIETIES.—A number of old standard varieties have been recently propagated and distributed. Many of them have not been sufficiently



THE NEWCASTLE APRICOT—A CALIFORNIA SEEDLING.

tested to determine value, but there are indications that they will follow the rule of the varieties generally grown and prove valuable in some situations and not in others. The large Early Montgamet and St. Ambroise have been largely distributed by the California Nursery Company. They have been tested by John Rock, in his orchard at San Jose, and pronounced vigorous and productive. I. H. Thomas, of Visalia, reports the Alberge de Montgamet a fine, large apricot, the best shipper he grows. A. T. Hatch, of Suisun Valley, has had such favorable results with the St. Ambroise on young trees that he is propagating it largely. The same varieties in some places directly subject to coast influences have not proved satisfactory. The Boulbon has been introduced by Felix Gillet, Albert Montpellier, and others, in the hope of securing a large early variety.

The tests made in the University orchard at Berkeley extended over several years, and were reported by W. G. Klee, in the College of Agriculture, Report for 1887. He mentions the following varieties as apparently unsuited to the locality, having produced but little fruit: Early Golden, Breda, Red Masculine, Turkey, Malcolm Breda. The Early Golden produced quite a large crop in 1880, but since that the tree has not borne ten pounds altogether.

Varieties of California Origin.

Pringle.—Catalogued by John Rock, as "of California origin, medium size pleasant flavor, clingstone, ripening in May." This variety is only of account because of its being the earliest of the older varieties. It is not worth planting except for home use in any but early localities, and it will probably be wholly superseded by better local seedlings.

Thissell's Seedling.—Originated in Pleasant's Valley, Solano County, and first grown in quantity by G. W. Thissell. A bright-colored clingstone, ripening just after the Pringle, and larger. Has been shipped East with good results.

Eureka.—Originated in 1884, by I. H. Thomas, of Tulare County, as the earliest large apricot. Described by W. H. Pepper, of Petaluma, in 1887, as the first apricot to ripen in his collection; of large size and good quality. Said to ripen two weeks earlier than the Peach.

Newcastle.—Originated with C. M. Silva & Son, of Newcastle, Placer County, in 1881; size full medium, round; rich golden yellow, with brilliant red cheek in the sun; freestone; flavor sweet and rich; tree a regular, heavy bearer and healthy; fruit ripens before Pringle. Has been shipped to Chicago successfully.

Smith's Triumph.—Originated with W. W. Smith, of Vacaville, who says of it: "The Triumph is as large, or larger, than the Moorpark; skin very thin; color a deep yellow, with orange cheek; flesh firm, rich, and juicy; separating freely from the stone, which is very small; ripens about ten days to two weeks before the Royal; tree a vigorous grower and very productive; an excellent shipper and canner, and heavy drier."—Trumbull & Beebe.

Routier's Peach.—Originated with Hon. Joseph Routier, near Sacramento. Introduced and described by W. R. Strong & Co., as follows: "Large, yellow in shade, deep orange, mottled or splashed with red in the sun; flesh juicy and rich, high flavor and a good market variety." Commended by J. R. Springer, of Woodland.

Finney's Peach.—Propagated and described by Luther Burbank, of Santa Rosa, as follows: "Exceedingly productive even near the coast; very large and handsome, even larger than Moorpark, and best of all for drying."

Goodrich's Peach.—Originated with O. O. Goodrich, of Sutterville, as seedling of peach, which it resembles. Ripens uniformly. Was in shipping condition June 3, 1887, and much larger than any other variety then ripe.

Vestal's Moorparks.—Two seedlings of Moorpark originating with D. C. Vestal, of San Jose. No. 1 is large, round, yellow, with high color, almost red next the sun; flesh firm, rich and juicy; fruit hangs a long time on the tree, which is a good bearer and vigorous, with large leaf and strong wood. No. 2 is a large fruit with sides somewhat flattened, rich, yellow color; flesh rich but not so juicy as No. 1. Tree is vigorous and strong and a great bearer, being some fifteen years old and never has failed of a good crop. These are seedlings which Mr. Vestal selected out

of several hundred because of their strongly-marked growth from the start. A. Block, of Santa Clara, State Horticultural Commissioner, pronounces No. 1 a fine variety. No. 1 ripens about ten days earlier than Moorpark; No. 2 ripens two weeks later than Moorpark, and is commended as a late variety for frosty situations.

ALLISON APRICOT.—Originated from seed of White Royal by Josiah Allison, near Vacaville. Commended by L. J. Harbison because of size, flavor, and freedom from overbearing.

BRIER'S ROYAL GOLDEN.—Originated with the late Rev. W. W. Brier, Centreville, Alameda County. Grown to some extent in Los Gatos District and said to bear often when others fail; large, yellow as Early Golden; tree has habit of Royal.

JACKSON'S SEEDLING.—Originated on the farm of Andrew Jackson, in Fresno County, from a seed planted by Mr. Hyde Described by W. A. Sanders in the *Rural Press*, September 9, 1882, as one of the largest and finest, flattened like the Peach, with brownish skin and dots of the Moorpark. It is seedling of the Peach, and like it has a bitter kernel. Propagated by I. H. Thomas, of Visalia, but his later experience is not favorable to it.

HINDS' SEEDLING.—Originated with Mr. Hinds, of Visalia, and brought into notice in 1884 by I. H. Thomas. The original tree in that year was thirteen years old and bore one thousand pounds of fruit. Fruit as large as Moorpark, perfect oval, shapely, finely colored and ripening evenly; said to ripen two weeks earlier than the Peach, and a few days later than the Eureka. It is commended by several growers for its delicious, rich, juicy sweetness.

WOOD'S EARLY.—Originated by T. J. Wood, of Riverside, in 187–. This variety was highly commended ten years ago for extra earliness combined with good qualities. Recent reports have not been favorable.

GORLEY.—Originated with Robert Gorley, near Freeport. Propagated by W. R. Strong & Co., and described as large and of good flavor.

CHRISTIAN'S MOORPARK.—Seedling of Moorpark by Mr. Christian, of Alhambra Valley, near Martinez. Described by Professor John Swett as equal in size to Moorpark and held to be even better flavored. Ripens evenly.

HOLLIDAY'S SEEDLINGS.—A seedling originating with M. B. Holliday, of Martinez; size medium, flavor good; ripens fifteen days later than Moorpark. Also an early variety "equal in size to Royal and early as Pringle."

THOMAS' LATE.—Originated at Centreville, Fresno County. Over average size; growth of tree similar to Royal; foliage similar. Ripens some two weeks later than Moorpark, and hangs well on tree before spoiling. It clings on one side of the pit a very little; a good shipper and valuable, as it prolongs shipping some two weeks.—*I. H. Thomas.*

STEWARD'S SEEDLING.—Originated with J. P. Steward, Winters. Said to be a little earlier and larger than Royal.

SPARK'S MAMMOTH.—Popular in Ventura County. Said to be the largest and best in the county.

There are several other seedlings now on trial by their propagators upon which judgment is reserved for the present.

TABULAR STATEMENT OF ADAPTATIONS.

Upon the following page is a tabular statement embodying reports from apricot growers—the table being prepared in the same way as the tables of apple varieties, described on page 251.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS NAMING VARIETIES OF THE APRICOT CONSIDERED MOST SATISFACTORY IN THE COUNTIES INDICATED.

COUNTIES OF CALIFORNIA.	Newcastle	Pringle	Breda	Thsell's Seedl'g	Large Early	Eureka	Smith's Triumph	E. Montgamet	Early Golden	Royal	Blenheim	Early Moorpark	Alberge de Mont	W. Masculine	H.n.l's Seedling	Hemskirke	Peach	St. Ambroise	Large Roman	Moorpark	Turkey	Vestril's No. 2
Del Norte																						
Humboldt										*	*											
Mendocino																						
Lake																				*		
Napa			*		*					*												
Sonoma						*			*	*												
Marin										*												
Contra Costa										*	*					*	*					
Alameda								*		*	*		*			*	*	*				
Santa Clara					*			*		*						*		*		*		*
San Mateo									*	*	*									*		
Santa Cruz					*				*	*	*					*				*		
San Benito					*					*	*											
Monterey										*												
San Luis Obispo										*	*					*			*	*	*	
Santa Barbara					*					*	*					*	*		*	*	*	
Ventura									*	*	*	*				*	*		*	*	*	
Los Angeles									*	*	*						*		*	*	*	
San Diego					*					*						*			*	*		
San Bernardino					*				*	*						*	*			*		
Kern						*				*							*					
Tulare						*				*			*		*	*	*			*		
Fresno										*					*		*			*		
Merced					*	*				*							*			*		
Stanislaus									*	*										*		
San Joaquin										*							*					
Sacramento					*					*							*			*		
Solano		*		*			*	*	*	*							*	*		*		
Yolo		*		*						*					*		*			*		
Sutter							*			*												
Yuba		*								*				*								
Butte		*			*		*			*	*						*	*		*		
Colusa										*										*		
Tehama					*					*										*		
Shasta																				*		
Trinity																						
Siskiyou																						
Modoc																						
Lassen																						
Plumas																						
Sierra																						
Nevada																						
Placer	*	*																		*		
El Dorado										*	*						*					
Amador										*	*											
Calaveras										*	*											
Tuolumne																				*		
Mariposa																						
Alpine																						
Mono																						
Inyo																						

CHAPTER XVIII.

THE CHERRY.

ALTHOUGH the amount of cherries grown in this State small as compared with the aggregate weights of some other fruits, the cherry, from the growth of the tree and the size and quality of the product, is entitled to rank as one of the grand fruits of California. The size of the California-grown cherry is a matter of pride with residents, and a marvel to visitors. It is related that one of the most distinguished Eastern pomologists, who was taken to an Alameda County cherry orchard during picking-time, could not recognize the varieties, though he had himself propagated and shipped to California the very trees which were bearing the fruit, the size of which so far surpassed all his mental standards. And quality is commensurate with size. Whatever disagreement there may be concerning the flavors of our other fruits as compared with Eastern, the richness and excellence of the California cherry have never been impeached.

FAMOUS OLD TREES.—The longevity and productiveness of the cherry tree in this State is naturally of interest. Cherries were planted in some of the earliest settled parts of the State and are still in full vigor. One of the most famous trees is a Black Tartarian, which was brought from France by Dr. L. E. Miller, and planted by him in 1854, on land now ownedb y Robert Hector, in Placer County, just below Rattlesnake Bar, on the American River, about eight hundred feet above sea level. It is described as sixty-five feet in height, the branches covering a space sixty feet in diameter. The trunk branches about six feet above the ground, and at that point has a girth of over ten feet. A close record of its crop has been kept, as follows: 1886, two hundred boxes, of ten pounds each; 1887, one hundred and eighty; 1888, three hundred; 1889, two hundred and twenty; and 1890, three hundred boxes.*

In the orchard of Dr. Tripp, at Woodside, San Mateo County, there are also cherry trees planted in 1853 which have trunks over two feet in diameter. They were headed low and are still in full vigor and bear freely. John Capura, of Oroville, has a tree of White Bigarreau now over nineteen years of age, nearly sixty feet high, six feet in girth of trunk, and is said to have borne two thousand two hundred and twenty-five pounds

*Essay by Robert Hector, *Pacific Rural Press*, Dec. 20, 1890.

of cherries in 1887.* In General Bidwell's orchard at Chico there is a tree of Napoleon Bigarreau sixty feet high, seven and one-half feet in girth, and twenty-five in length of branch, which, in 1886, yielded one thousand seven hundred and fifty pounds, which sold at the cannery for five cents per pound, or $87.50 for the tree.† The same tree in 1887 yielded "almost a ton of cherries, which sold at an average of ten cents per pound, or almost $200 for the crop of a single tree.‡ These are large trees of well-known cultivated cherries. In Bassford's Cañon, near Vacaville, there is a seedling Mahaleb, believed to have been planted in 1857, which has at least forty feet spread of branches and is twenty-five feet high, the branches emerging low, growing outward, and drooping to the ground.

LOCALITIES FOR THE CHERRY.

The counties which produce the greatest amounts of cherries at present are Alameda, Santa Clara, Solano, Napa, Placer, Sonoma, Santa Cruz and Sacramento, about in the order named; Alameda and Santa Clara together having more than half of all the bearing trees in the State.

There has been an idea that the area adapted to the growth of the cherry is quite limited. The great valley was generally condemned, though at some points the trees grew well, but did not bear. Southern California, both on the coast and in the interior, was announced as unsuited for the cherry. Later experience is recording successful growth and fruitage of the tree in many places where it has long been regarded a failure. It is rather early to attempt to determine the causes of the apparent failure, or to measure the area which present indications of success may cover. It seems likely, however, that much of the early disappointment may have resulted from lack of attention to the soil and moisture conditions which best suit the tree, and if this be true, much may be hoped for as the ultimate result of experiments now in progress.

How far atmospheric conditions which are beyond control influence the growth and fruitage of the cherry, cannot be fully determined. Even where these are plainly the cause of the trouble, there is still the hope of securing varieties of the fruit which have been developed under conditions similar to those prevailing in the interior of California. Professor J. L. Budd, whose opinion with reference to the suitability of some Russian apples has been cited, believes that the Russian cherries, which are

* Oroville *Register*, May, 1887.
† Dr. H. Latham, in *Record-Union*.
‡ Dr. C. C. Parry, in *Overland* for June, 1888.

largely grown in a region subject to high summer heat and dry air, will succeed in parts of California where the varieties originating in west Europe fail. This suggestion should lead to local experiments.

The errors in soil and water conditions, which are subject to correction or to avoidance, will appear in consideration of the wants of the cherry as learned by experience and observation.

SOILS FOR THE CHERRY.

The cherry demands free, deep soil, in which water does not stand within about fifteen feet from the surface. It delights in deep deposits from old water courses, and does not dislike a moderate amount of sand. A loam underlaid by a sandy subsoil is acceptable, but a loam underlaid by clay has shown its unfitness by the early failure of the trees, while those on deep

SCENE IN A CHERRY ORCHARD, SAN JOSE.

loam near by have remained vigorous and profitable. On the foot-hills it thrives in the light, mellow soil and fails in the tight clay either in soil or subsoil, as it does in the adobe of lower lands. The great cherry trees of Mr. Hector, in Placer County, which we have mentioned, are growing right on the bank of the American River, where the soil is a pure, sandy loam, in some places over sixty feet deep, as proved by an old shaft once dug near the center of the orchard.

But though the cherry prefers a dry rather than a wet soil, it is particular about its water supply and insists upon enough, its requirements being greater than some other trees. Thus the cherry growers in the famous Willows district, of San Jose, usually find it an advantage to give their trees an irrigation between the spring rains and the ripening of the fruit. In Vacaville, on a somewhat similar mellow soil, growers do not find irrigation necessary; the explanation is found in the fact that the rainfall at Vacaville has an annual average of thirty inches, and San Jose fifteen inches.* In the foot-hills of Placer County, where the rainfall is about as heavy as at Vacaville, the cherry usually requires moderate irrigation, because of the more rapid drying out which is characteristic of foot-hill situations. Mr. Hector describes his practice as follows:—

Irrigating is begun immediately after the gathering of the crop, the rather severe handling that each limb receives at picking-time, in spite of extreme care, seeming to make water particularly acceptable at this time. It has the effect of strengthening the fruit spurs and invigorating the tree generally.

A similar contrast in local conditions is found in Southern California. Cherries are grown at Mesa Grande, in San Diego County, fifty miles eastward from the Pacific Ocean, and at an elevation of three thousand three hundred feet, without irrigation, but the soil is fairly retentive and the average rainfall thirty inches.† Mr. Gedney says:—

I think the altitude cuts but little figure in the production of the cherry; it depends more on the quality of the soils and a sufficient annual rainfall, say an average of thirty inches per year. Plant upon well-drained hillsides, no matter how rocky, providing it is not too rocky to cultivate. These rocks keep the soil loose, and the heat they gather through the day is thrown off at night, keeping the soil warm.

But it is either elevation or character of soil which justifies Mr. Gedney in drawing this conclusion for his locality, for thirty inches of rainfall will not alone insure success everywhere, as has already been pointed out.

These facts show that the cherry must have enough water or it will not succeed. On the other hand, there must not be excessive moisture in the soil either from irrigation or by moisture. Cherry trees in Southern California, planted with orange trees and given similar irrigation, have failed utterly. Planting on naturally moist land in low places has also failed, and observed facts some time ago led to the conclusion that at the South the cherry should be planted on well-drained land, which could be irrigated (as the behavior of the tree indicated its need of water), rather than on naturally moist land, because of the likelihood of excessive moisture in such situations. More recent

* Report of Sergeant Barwick, in report of California State Agricultural Society, 1887.
† J. E. Gedney, in *Pacific Rural Press*, Dec. 8, 1888.

experience has declared the mellow, well-drained soils of the mesas well adapted to the cherry, and on such soils, when well cultivated, cherries have done well without irrigation at Pasadena, Pomona, and elsewhere. Mr. Gedney, who has had seventeen years' experience at Mesa Grande, in San Diego County, writes:—

I have experimented with the soil of the lowlands, second bench and hillsides, or slopes best adapted to the cherry, especially those having a northern or western exposure. These hillsides are rocky, no outcropping of ledges, but loose rocks from the size of a walnut up to quite large bowlders abound. The soil when wet is of a dark iron color, and when dry of a dark gray color, and consists largely of mica, iron, and decomposed granite, with an under layer of a reddish clay; is very easily worked and not inclined to bake.

CONCLUSIONS.—These facts form the foundation of a conclusion that the cherry has been pronounced a failure in many places, because sufficient attention was not paid to the disposition of the tree with reference to soil and moisture conditions. The soil must be mellow and free. It must not be naturally wet, but still of a character in which well-distributed moisture can be retained by cultivation. Both dampness and drought in the soil are alike unfavorable. These conditions seem of greater importance than atmospheric influences, for near the coast, as at Petaluma, Santa Cruz, and Ventura, and in the interior, as in Kern and Tulare Counties, good cherries have been grown. And yet interior situations are sometimes subject to excessively hot winds which destroy the crop. It is reported that at Mesa Grande there was a hot wind in 1890 which "literally cooked the ripening cherries on the trees." Similar injury, though in less degree, is occasionally experienced in other regions.

Still, though it seems likely that there will ultimately be many cherries grown in parts of California hitherto thought unsuitable, large ventures should not be made without careful local experimentation. In such places a few trees of quite a number of varieties should be planted and treated according to the best judgment which can be formed of their requirements, and the results attained will be the best possible guide to a future course. Large plantings for commercial purposes should be made in well-tested localities.

In California, as elsewhere, the Dukes and Morelloes succeed where the Hearts and Bigarreaux fail. The May Duke seems especially hardy, and bears well in Nevada, where other sorts fail utterly.

LATE FRUITING OF CHERRY TREES.—Though the cherry in favorable situations bears early, the grower, especially on strong, rich lands, will often have many years of disappointment from falling blossoms and fruit. During this time the trees will

be making marvelous wood growth, and this apparently suppresses the fruiting function. Usually these trees will ultimately bear when their exuberant growth declines. They can be thrown into fruit sooner by root pruning, digging a trench around about eight feet from the tree, and severing the roots thus encountered, or by summer pruning of twig ends. Because of this overgrowth, growers give such soil to the apple or the pear rather than the cherry. Sometimes the non-bearing of the cherry is inexplicable. Though everything seems to be right, and the blooms are profuse, the fruit will not stick. Some think it is due to lack of association of different varieties and cross fertilization. Fortunately, the phenomenon is rather rare.

EXPOSURES FOR THE CHERRY.

Exposures for the cherry are chosen both with reference to protection from frost injury and to early ripening of the fruit. Some situations combine these two considerations; in fact, the first is necessary to the second, but the second does not always accompany the first. The cherry blooms early; it is almost as venturesome as the almond. In protected situations, guarded from cold northerly winds, and open to sunshine on the south and southeast, the fruit advances to maturity very rapidly. In Vaca Valley about a month of good weather after the blossoming will ripen an early cherry. The most famous cherry growers of Vaca Valley, the Bassfords and W. W. Smith, went there from their old homes in Napa Valley, because they could gather and market cherries in their new locations before the same varieties were ripe in Napa. They both chose places protected on the north and west by steep hills. Mr. Smith's early cherry trees are but little elevated above the flow of the valley, but the steep bluff on the north protects them. Elevation is also an important factor to the same end, for on the top of the bluff which shelters Mr. Smith, the Robinson Brothers and others are competing with him for the distinction and profit of getting the first cherries to market. The two things to secure are, apparently, protecton from the sweep of cold winds and elevation above the deposit of cold air, which occurs in depressed places. Mr. Hector gives this description of the situation of his famous orchard:—

The trees grow in a bank of rich alluvial deposit located above the north edge of the bank of the American River, which here, in its winding, runs almost due west. It is in a valley formed by the depression between two spurs of the ridge which forms one side of the river cañon. This valley is sheltered by hills on the east, west, and north, and opens to the river on the south. It is, therefore, protected from cold winds and has the advantage that southerly exposures always have. The top of the bench or table upon which the orchard is situated lies about forty feet above the level of water in the American River at its ordinary stage in summer. My records of temperature are somewhat meager, but sufficient to show the results of the protection afforded by the peculiar location.

In localities where fruit ripens late, as near the coast, there is no need to seek forcing conditions, for the extra early varieties should not be planted except for family use. Early varieties are comparatively poor in quality, and will not sell profitably, as they will reach the market alongside of better later sorts from earlier districts. The place for the cherry in the later districts is on the most proper soil, according to the requirements which have been laid down, avoiding, however, so far as possible, wind-swept spots, and seeking amelioration of direct ocean influences by elevation or by intervention of hills and wind breaks.

PROPAGATION AND PLANTING THE CHERRY.

In the chapter on propagation is given a successful method of growing cherry seedlings, also the choice of stocks approved by California experience.

IN THE CHERRY ORCHARD OF W. W. SMITH, VACA VALLEY.

The planting of the cherry is covered by the general considerations already given for the planting of orchards. The distance which cherries should be set apart is a disputed point among planters. Mr. Hector, drawing the suggestion from his mammoth trees, would plant them eighty feet apart on such soil

as his, and thinks forty feet near enough on any good soil. This is the extreme of all distances which have been named, and looks to the needs of the trees a generation ahead. This is farther in the future than most growers care to calculate, and would prefer to let the coming generation cut out some of the trees if necessary. Still trees should not be set too close. Mr. Smith's famous orchard at Vacaville is planted twenty feet apart for strong growing kinds, and eighteen feet for less vigorous ones, but his oldest trees, though now but sixteen years old, have interlaced their branches, and the spaces between the rows have been covered in like colonnades. In the Haywards region the branches of twelve-year-old trees set twenty-eight feet apart have nearly reached each other, though continually cut back. G. M. Gray, superintendent of the Rancho Chico orchards, advises planting the cherry thirty-three feet apart.

Much depends in the matter of distance upon the manner of handling the trees. If the vigorous pinching or spur pruning, as practiced for years by W. C. Geiger, of San Jose, and which will be described presently, be adopted, the trees can be grown much nearer together than where the usual way of cutting back for the first few years and letting the tree take its natural growth after that, be followed. James E. Gedney, of Mesa Grande, San Diego County, practices close planting and cutting back. He says:*

> I plant my trees twenty feet apart each way. My method is to plant thus closely and then keep my trees low, by cutting back every year; this facilitates gathering the fruit very much. I prefer this way to setting the trees farther apart and allowing them to attain too great a height. By the former method I secure fully as good, if not better, results per acre, to say nothing of the difference in gathering the fruit. Another advantage in keeping the trees headed low is that the wind does not affect them nearly as much as it does tall trees.

Thus it appears that one may fix his distance in planting according to the method of pruning he proposes to follow, remembering, however, that the cherry is naturally a large tree, and most old orchards are now overcrowded.

As with other trees, orchard planters prefer trees with one year's growth on the bud in the nursery, because they usually get, then, a straight switch with well-developed buds all the way down, and the head can be formed as desired. For garden planting older trees, properly pruned in the nursery, can be used to advantage.

PRUNING THE CHERRY.

All our best growers agree in the advantage of a low head for the cherry, and all aim to have the trunks from the ground

**Pacific Rural Press*, Dec. 8, 1888.

up to the limbs literally covered all around with leaves, which completely shelter the bark from the rays of the sun. In planting, therefore, the side buds are carefully preserved—not to be grown into branches, but to be cut or pinched back when they have come out a few inches, leaving just growth enough to clothe the tree with a covering of its own foliage. This was early insisted on by Mr. Geiger, of San Jose, and as we have mentioned it we will proceed first to describe his method of growing the cherry tree, as shown by the following illustration.

NATURAL AND TRAINED GROWTH OF YOUNG CHERRY TREE.

The first figure shows the way unpruned young trees usually grow in this State, shooting upward quickly and exposing their stems to sunburn and borers. The second figure shows Mr. Geiger's method of developing spurs from the ground up to the head. These spurs not only furnish leaves to shade the trunk, but soon become fruit spurs and bear well. But this figure also shows Mr. Geiger's way of shaping the upper part of his tree by carrying up a leader with a regular system of side branches. He heads back at planting to two feet, pinching off the shoots below the head as stated, and allowing the shoots which form the head to grow larger, but they too are all pinched except the leader, which is allowed to grow as long as it pleases during the summer. About February or March, for Mr. Geiger does not believe in pruning the cherry until the buds begin to burst in the spring, he cuts back the leader to about twelve or sixteen inches from its starting-point and cuts back the side branches to about six or eight inches. This is done year after year, cutting back and thinning out the sideshoots, pinch-

ing the laterals, and allowing the leader to grow, never interfering with it until the spring pruning, and always letting it predominate over the side shoots. By cutting short, wood is increased, but at the end of six years the tree goes into fruit very rapidly. As the tree increases in fruit, it decreases in wood, and by the time it is ten or twelve years old there will be but little cutting to do, except to shorten in and thin out, and this requires some judgment and experience, to know where to cut, how to cut, and when to cut. To shorten in, never cut down to an old fruit spur. It is very difficult to get healthy wood out of such; but whenever you can find last year's wood there you can cut with safety anything that is less than one inch in diameter.

This system of pruning must be accompanied by constant pinching during the summer-time. It should commence when the lower shoots are about six inches long, and be followed up closely all through the growing season. Those on the trunk should never get longer than eight or ten inches, under any circumstances. After these are pinched, let the trees rest ten or fifteen days, or until the branches in the top get a good start. Then pinch everything clean but the leader, in every main branch in the tree. The leader takes its own way all through the growing season, to prevent the effects of over-pinching or checking growth. If only the side shoots are kept back, the leader or head of the branches receives the current or flow of sap and maintains and carries on life and vitality in the tree. One object in pinching or spur pruning is to keep back surplus wood and create fruit spurs, throwing all the little twigs and branches into fruit, thereby utilizing all the wood the tree can produce, not allowing it to grow at the tree's expense, and then have to cut it off. And another object in side shoot pruning is to make the tree produce fine large cherries, all closely nestled around the big wood, and no long, slim branches hanging down like weeping willow. All such branches are always more or less sunburnt on the top and full of worms, one of the evils tending to the destruction of the tree.

Mr. Geiger's method is commended to those who like a tree with a central leader, and are willing to give their orchards such constant attention as he does. His orchard near San Jose shows that his system is practicable; in fact, he has followed it for a life-time.

THE USUAL METHOD OF PRUNING THE CHERRY.

As we have said, all cherry growers agree on low heading and on the advantage of pinching the lowest shoots as soon as they make a bunch of leaves. In forming the head, and in

after treatment, the usual method is quite different from that we have described. It follows the vase or goblet form, which has been discussed at length in the chapter on pruning. Of the application of this method to the cherry, W. W. Smith, in an address before the State Horticultural Society, said:—

The cherry may be pruned the same as any other deciduous fruit tree, until it is about five years old; after that the less pruning the better, except when necessary to cut out a dead or crossing branch. Pruning the cherry is more or less likely to produce gum (and this, decay), and should be avoided as much as possible. Cherry trees, however, should be trained with low heads not to exceeed eighteen inches from the ground to the first branches; fifteen inches is better. From three to five branches are enough to form the head of the tree; all others should be removed early. Three are better than five; two makes a forked tree, which is likely to split down in after years.

At the end of the first season we have a neat little tree with three to five branches. During the following winter these branches should be cut back from six to eight inches. The next season these should be allowed to produce two branches each (no more); then, at the end of the second season from planting out, we have a tree with from six to ten branches. The following winter the new growth should be cut back again to from twelve to eighteen inches—according to the amount of growth the tree makes—the less the growth the more you cut. The same process should be repeated the following winter, treating each branch as an individual tree, until the tree is about five years old; it takes at least five years to get the head of a cherry well established. After this, as some varieties will persist in throwing out branches near the ground, they should be removed during the summer. At this age the tree, if well grown, will have top enough to shade its body from the sun, and there is no further need of branches on the main trunk.

If necessary to remove large branches it should then be done *in midsummer*, as that is the only season when the gum is not more or less exuded. We make it a rule to go over and dress up and prune our cherry orchard immediately after the crop is gathered—which in our part of the State is the last of May. All wounds made then by the removal of branches or otherwise will heal over the same season. All large wounds made at any time, however, should be coated over with a solution of gum shellac dissolved in alcohol to about the consistency of paint. This can be easily applied with a brush, the same as paint. It hardens on the wound, and forms, as it were, a scab, and as the new growths are laid on it lifts up and finally drops off.

The method thus described by Mr. Smith is that by which probably nine-tenths of the cherry trees of this State are shaped. The engraving on page 161 shows a young cherry tree started on its course according to the method described by Mr. Smith.

As already stated, Mr. Gedney, of Mesa Grande, practices continual cutting back of the cherry to keep the tree small. His practice is as follows:—

At the time of planting I head back the young tree to about eighteen inches, thereby securing large, thrifty shoots below that point. This low heading I find very satisfactory, as the lower branches protect the body of the tree from the sun's heat, thus preventing sun scalds, gum sores, and sap souring. I cut back in February two-thirds the growth of the previous year. In this locality the cherry tree is inclined to grow large and very tall, say at four years twenty feet high. I cannot let them have nature's way, or else all I could do would be to stand at the base of the trees and look up at the too inviting fruit, and wish I had been raised by irrigation that I might have grown correspondingly tall, so as to reach the topmost branches.

In the cherry there should be the same observation as to cutting inside and outside buds as with other trees; in fact, the outside bud is the rule, because so many varieties make a directly upright growth. In removing limbs, cutting to the collar or swelling at the base of the limb is especially important, also the covering of the wound with shellac or hot grafting wax, as mentioned by Mr. Smith, for the cherry is very sensitive to removal of large limbs.

GRAFTING OVER THE CHERRY.

Since canning of cherries began on a large scale, there has been a vastly increased demand for white cherries. The Royal Ann (a local name for Napoleon Bigarreau) has been the favorite, but this position is now closely contested by the Rockport Bigarreau. Other white sorts are also used for canning. This rise in favor of the white cherries has vastly increased their proportionate production as compared with the choice black and red varieties, which are still popular as table fruit.

It is the experience of growers that the cherry is grafted over as easily as the pear or apple, if the tree is healthy. In large trees as many as fifty or one hundred grafts may be set, choosing the smaller limbs, even if you have to go pretty high in the tree. J. W. Cassidy, of Petaluma, advises grafting before the sap begins to flow in the winter, or if not done then, wait until the buds are well advanced or the tree in bloom. He has trees which were over thirty years old before they were reheaded and they now have fine tops of new and healthy wood, and produce abundantly.

PESTS AND DISEASES OF THE CHERRY.

The disease of the cherry which is most heard of is the "gum," or overflow and condensation of sap, which, if left to itself, often induces decay of adjacent bark and wood. Without attempting to explain the cause or causes of the unhealthy exudation, it may be said that prompt treatment of certain manifestations is desirable, and in others the tree should be cleansed from the flow. Where the gum exudes on the side of trunk or limb, the thin outer bark should be pared away with a sharp knife, the accumulation of gum and sap removed, and the wound painted with the shellac and alcohol paint. Mr. Geiger uses for this purpose a mixture of two parts of resin and one of shellac melted together, adding a small piece of tallow to the melted mass. Gum in the crotch should be cleanly brushed out when softened by the winter rains. If allowed to remain, it becomes sour and offensive, and may injure the tree. In places

where two or three limbs come out close together a kind of cup is formed, which will hold the gum from one year's end to another, and, in its soft state, leaves, sticks, cherry pits, dust, and dirt will stick and hang, and sometimes the mass becomes so foul that the stench can hardly be endured. By this collection, also, a nest is made for all manner of insects, bugs, and worms. Another evil in letting the gum stay on is, if rain does not wash it off clean, it runs down the trunk of the tree and makes the bark look bad, and if it is very thick on the bark when it dries, it will contract and crack the bark crosswise, and is very injurious to the tree.

Of the occurrence of gum in the crotch, Mr. Geiger gives the following interesting explanation:—

THE FORMATION OF GUM.

In the forks of cherry trees there are two barks on the inside of the wood, consequently there is a space of wood from three to twelve inches long that does not unite. This space or length of wood not united varies according to the age of the tree. Hence comes the liability to split open. The issuing of gum from the fork depends upon the relative position the branch sustains to the trunk of the tree. Thus in the accompanying illustration it is seen that it is the branches that grow nearly parallel with each other that gum the worst at the two barks, while those that grow more horizontally do not gum at all, because the wood is united, consequently there are two barks, the wood being solid. It is the same with those on the right of the illustration.

The two barks are caused by the branches growing so close together, and by the expansion of the large limbs in their growth the bark of both is forced in between the woods, so that it is impossible for the wood to grow together. The sap is forced in between these two barks and pursues a downward course until it arrives at the lower edge of the bark, where the wood is solid, and is then forced out of its natural place between the barks, and so finds its way out, and then we have it in the shape of gum in the fork of the tree. The cherry tree always issues its gum just under the bark, and not in the wood, as some people think.

In shaping young trees a gumming joint sometimes may be clearly cut out and those branches selected to remain which start out more nearly at a right angle; in older trees there is nothing to do but keep the fork clean, as already described.

There are cases reported in which gumming of old trees has been stopped by allowing the ground to lie uncultivated, weeds being cut down with the hoe. Some trees which persisted in making rank wood growth, and bearing no fruit, have been made fruitful by the same treatment. As a rule, however, the cherry thrives with good cultivation.

THE GOPHER.—One of the most dangerous foes of the cherry is the gopher, for he seldom takes less than the whole tree, young or old. Traces of his presence should be constantly watched for, and a little strychnine in pieces of carrot or melon dropped in his runway; besides poisoning, traps are used, and the gopher and squirrel smokers, which have been widely introduced of late, are successfully employed. If a tree is seen to wilt suddenly, the probability is that a gopher has girdled it. Covering the wound with shellac sometimes saves the tree, but not usually.

Insects injuring the cherry will be mentioned in a subsequent chapter.

PICKING AND PACKING CHERRIES.

Cherries should always be picked in the cool of the day if possible; pick with the stems on and take care not to break off the fruit spurs.

Cherries are usually marketed in boxes or drawers holding ten pounds each; if drawers are used, they are slipped in chests holding twelve drawers, or in crates holding four drawers. All packages should be neatly faced; that is, the first layer should be neatly arranged in the bottom of the box with the fruit lying side by side and the stems upward. The box is then filled without arrangement and enough put in so that nailing on the cover will gently press the fruit without crushing. In opening the box the bottom is removed and the fruit appears smoothly and evenly arranged. In packing drawers a tin form is used, and when full, the drawer is inverted over it. Withdrawing the tin form leaves the faced fruit on top. Whatever kind of package is used, great care should be taken in handling the fruit from first to last. Packing cherries is quite an art, and but few persons can do it neatly and expeditiously. A lady with small, slender fingers does best, but it takes practice on the part of anyone to succeed well. All dust and dirt should be avoided as much as possible. Persons working with cherries, either picking or packing, should wash their hands frequently through the day, as there is on all cherries more or less gum, and this will collect dust and dirt. All parts of the packing house should be kept well sprinkled down.

VARIETIES OF THE CHERRY.

Many varieties of the cherry have been tested in this State, and many have been abandoned from one cause or another. Those most frequently starred in our table are the survivors in public esteem. As our reports have come from those who grow for market, possibly some sorts too tender for shipment, but

excellent for family use, are omitted. The claims to value upon which a variety is judged are several: Extra earliness, an important consideration in early districts for shipment, and elsewhere for local sale or family use; firmness to withstand mechanical injury by jarring in transit and durability to escape decay during the long journey to distant markets; firmness and fixed color to stand processing in the cannery and to prevent coloring the juice; lateness to extend the cherry season.

In classification of cherries it was originally considered that there were four classes of cherries. The Hearts were the tender and half-tender sweet cherries, while the Bigarreaux were the firm-fleshed ones; but these have been so intermingled and blended together by hybridization that no distinct line can now be drawn separating them. There is really but one class of these, whose main characteristic is the large, vigorous growth of the tree. The Duke and Morello cherries, also wanting a natural division, really constitute but one class.

In arranging the varieties most popular in this State, the above position taken by Downing has been followed. It has also been attempted to arrange the varieties *approximately* in the order of their ripening. From lack of opportunity to observe all the varieties named, the writer does not claim that the arrangement is exact in this respect.

The brief descriptions of standard varieties are in the main condensed from Downing, modified, however, in some respects, by reference to experience and observation of California growers and nurserymen.

In addition to the old standard varieties, a number of Pacific Coast seedlings have become popular, and others are very promising. Special description of these seedlings will follow the standard sorts.

BIGARREAUX AND HEARTS.

EARLY LAMAURIE.—Fruit large, dark purple; flesh rich, juicy, excellent. Downing says a week earlier than Early Purple Guigne. Has proved the earliest cherry in the University collection at Berkeley, and in Vacaville district. Not fully tested as to regular bearing.

GUIGNE MARBREE.—"Fruit medium large, round, skin dark red; flesh purplish red, tender, juicy, delicate flavor."—*Gillet.* "A better bearer than Early Purple Guigne."—*W. W. Smith.*

BAUMANN'S MAY (Early Black Guigne).—Rather small, deep rich red, becoming rather dark when fully ripe; tender, juicy, tolerably sweet and good.

EARLY PURPLE GUIGNE.—Small to medium size; purple; tender, juicy, and sweet. This variety is considered the earliest good cherry. It is reported a shy bearer in some localities.

BELLE D'ORLEANS.—Above medium size, roundish, heart-shaped; whitish yellow, half-covered with pale red; very juicy, sweet and excellent.

EARLY WHITE HEART.—Below medium size, rather heart-shaped, skin dull whitish yellow, tinged and speckled with pale red in the sun; flesh melting, sweet, and pleasant when fully ripe.

WHITE TARTARIAN.—Fruit of medium size, obtuse heart-shaped; skin pale yellow; stalk slender; flesh whitish yellow; half tender and very sweet.

AMERICAN HEART.—Fruit pretty large, heart-shaped, often nearly four-sided and irregular in outline; borne in clusters; flesh half tender, skin strong and adhering to flesh.

WERDER'S EARLY BLACK.—An early variety, moderately productive; tree vigorous, spreading; fruit large, black, tender, sweet and excellent.

KNIGHT'S EARLY BLACK.—"Large, black, tender, juicy, rich, and excellent; high flavor; a shy bearer until the trees attain age."—Robert Williamson.

ROCKPORT BIGARREAU.—Large; pale amber in the shade, light red in the sun; half tender, sweet and good; a very excellent and handsome cherry; good bearer; highly esteemed for canning and shipping.

COE'S TRANSPARENT.—Medium size; pale amber, red and mottled next the sun; tender, sweet and fine.

CLEVELAND BIGARREAU.—A thrifty, strong, spreading grower, and productive; large; clear red and yellow; juicy, sweet, and rich.

BLACK TARTARIAN.—Fruit of the largest size, bright purplish black. Flesh purplish, thick, juicy, very rich and delicious. Tree a remarkably vigorous, erect, and beautiful grower, and an immense bearer; the best of the black cherries.

GOVERNOR WOOD.—Large; light yellow shaded with bright red; flesh nearly tender, juicy, sweet, rich and delicious; a vigorous grower and very productive.

ELTON.—Large, pointed; pale yellow, nearly covered with light red; juicy, with a very rich and luscious flavor; one of the best.

BLACK EAGLE.—A very excellent English variety, ripening in June; large size, deep purple, or nearly black; flesh deep purple, tender, with a rich, high-flavored juice.

AMERICAN AMBER.—Fruit medium sized, roundish, heart-shaped; skin thin, smooth, light amber, delicately mottled and overspread with bright red; flesh tender and juicy, but not high flavored.

BIGARREAU (Yellow Spanish, Graffion).—Large; pale yellow, with red cheek in the sun; flesh firm, juicy, and delicious; one of the best, most beautiful, and popular of all light-colored cherries.

GREAT BIGARREAU (Monstrueuse de Mezel).—A foreign variety of the largest size; dark red or quite black; firm and juicy; late.

PONTIAC.—Large; dark purplish red; half tender, juicy, and agreeable.

BURR'S SEEDLING.—Large; yellow, shaded with red; sweet and rich; vigorous and great bearer; apparently does better near the coast than in the interior.

OXHEART.—Fruit large, obtuse, heart-shaped; skin dark red; flesh red, half tender, with a pleasant juice of second quality.

NAPOLEON BIGARREAU (Royal Ann).—A magnificent cherry of the largest size; pale yellow, becoming amber in the shade, richly dotted and spotted with deep red, and with a bright red cheek; flesh very firm, juicy and sweet. Tree a free grower and an enormous bearer.

TRADESCANT'S BLACKHEART (Elkhorn) —Large, heart-shaped; deep, glossy black; very solid and firm; dark purple, moderately juicy.

SCHMIDT'S BIGARREAU.—"A new German variety lately introduced. The largest of all the Black Bigarreau cherries. Skin of a deep black color; flesh dark and very juicy, with a fine flavor."—John Bidwell. Reported thus far a shy bearer, by James Shinn, Alameda County.

DUKES AND MORELLOS.

EARLY RICHMOND (Kentish).—An early, red, acid cherry; valuable for cooking early in the season.

MAY DUKE.—An old, well-known, excellent variety; large, dark red, juicy, subacid, rich.

ARCH DUKE.—Fruit large, obtuse, heart-shaped; bright red becoming dark; flesh light red, melting, juicy, rich, subacid flavor, very good; tree more upright; and vigorous than May Duke.

THE CENTENNIAL CHERRY—A CALIFORNIA SEEDLING.

LATE DUKE.—Fruit large, flattened or obtuse, heart-shaped; white, mottled with red, becoming rich dark red when ripe; flesh yellowish, tender, juicy; hangs long on the tree.

REINE HORTENSE.—"It is one of the very largest of cherries; a beautiful, glossy red, or deep pink, when fully ripe; heart-shaped; a universal bearer, and when hanging on the tree no fruit is more beautiful; excellent for canning, but too soft and juicy for shipment."—W. W. Smith.

ENGLISH MORELLO.—Large, dark red, nearly black; tender, juicy, rich, acid, productive and late.

GUIGNE NOIR LUISANTE (Black Spanish).—Fruit medium size, round, heart-shaped, glossy, blackish red; flesh reddish purple, tender, juicy, rich, acid.

BELLE MAGNIFIQUE.—Fruit large, roundish, inclined to heart-shape; skin a fine bright red; flesh juicy, tender, with sprightly subacid flavor; one of the best of its class; a fine table fruit when fully ripe.

PACIFIC COAST SEEDLINGS.

BLACK REPUBLICAN (Lewelling, Black Oregon).—"Seedling by Seth Lewelling, Milwaukee, Oregon, from seed planted in 1860; first fruited in orchard in 1864. Widely distributed in California. Large, black, sweet, with purple flesh; ripens ten days after Black Tartarian."—James Shinn. "Large, late black cherry, good flavor, long keeper; dries and ships well. Seems to succeed better on foot-hills than in the valley."—Robert Williamson. "Supposed to be a cross between Napoleon Bigarreau and Black Tartarian, having the solid flesh of the former and the color of the latter; very late."—John Rock. "I am of the opinion that the Black Republican and Lincoln came from the seed of the Black Eagle, but I have little idea of what variety they were crossed with."—Seth Lewelling.

LINCOLN.—Same origin as Black Republican; first fruited in orchard in 1865. Original trees of Black Republican and Lincoln are still sound and vigorous, the latter yielding, in 1886, fifty-two ten-pound boxes.

LEWELLING.—Originated by Seth Lewelling, from seed of Black Tartarian. Fruit deep, rich, cherry color; large, firm and fine flavored; late. Fruit picked July 11, 1876, was sent to the Centennial Exposition at Philadelphia, and won for Mr. Lewelling the first premium.

BING.—Originated by Seth Lewelling, from seed of Black Republican. "Fruit large, dark brown or black, very fine; late; a good shipping variety."—Seth Lewelling. Tree vigorous, and foliage heavy.

CENTENNIAL.—A seedling of Napoleon Bigarreau, raised by Mr. Henry Chapman in Napa Valley, and fruited by him for the first time in 1876. Propagated and introduced by Leonard Coates, of Napa, in 1885. It is larger than its parent, more oblate in form, and beautifully marbled and splashed with crimson on a pale yellow ground; exceptionally sweet and of remarkable keeping quality. Described by Committee of American Pomological Society (1885) as follows: "Size large, slightly oblate; amber, with dark crimson marbling; flesh firm, sweet, and rich; quality best; condition excellent (after crossing continent by mail), showing its good shipping qualities." "As compared with Royal Ann, the Centennial is more obtuse, heart-shaped, more mottled in its coloring, more meaty, more juicy, and yet quite as firm."—W. W. Smith. "It has a smaller pit and more sugar."—A. T. Hatch.

CALIFORNIA ADVANCE.—Originated by W. H. Chapman, of Napa, propagated by Leonard Coates, of Napa. Seedling of Early Purple Guigne, ripens one week earlier than its parent; is larger and of more obtuse, rounded form, and said to be a heavier bearer; dark purple turning black; rich and sweet, and of good degree of firmness.

PURITY.—Originated and propagated by same parties as above; seedling of Elton; beautiful, waxy, transparent; more rounded and firmer than Elton; ripens a week before Napoleon Bigarreau; seed small; tree prolific and regular bearer.

BLACK MASTODON.—Originated and propagated as above; seedling of Pontiac; ripening with Centennial; size very large, whence its name; flesh firm; expected to be a good shipping cherry.

THOMPSON'S SEEDLING.—Originated in Napa County. Seedling of Black Tartarian, resembling it closely. Tree hardier than Black Tartarian, and a better variety in some localities. "The best black cherry in the State; firmer than Black Tartarian; rich quality and a good shipper."—Dr. E. Kimball. "A shy bearer in Vaca Valley."—W. W. Smith.

THE OREGON.—Seedling of Napoleon Bigarreau, by H. W. Prettyman, of East Portland, and named by Oregon State Horticultural Society in 1888; described as larger than Napoleon; firm; dark red; "fit to eat earlier than Napoleon, but coming to full maturity somewhat later." Introduced in 1888, by W. S. Failing, Portland.

MAJOR FRANCIS.—Seedling by G. W. Walling, Oswego, Oregon, about 1865; named by a committee composed of A. J. Dofer, Charles Maltterop and W. S. Failing in honor of Major Francis, of Portland. Fruit large, dark, fine flavor, early; too tender for long shipment.

WILLAMETTE.—Another seedling by Walling; "fine for home use."

UNNAMED.—Seedling by J. H. Lambert, Milwaukee, Oregon, 1888. Very large; dark rosewood mottled; long and pointed, quality good, flesh firm; tree vigorous and upright, but so far rather shy bearer. Also seedling by J. H. Settlemeier, Woodburn, Oregon; very early; extra large; very sweet, flesh tender and unfit for shipping.

KNAPP'S SEEDLING.—By George Knapp, near Lafayette, Oregon; introduced by E. R. Poppleton, about 1885; round, black, medium size; tree very thrifty.

TABULAR STATEMENT OF ADAPTATIONS.

The following tabulation of reports on the cherry is governed by the conditions fully described in connection with a similar statement concerning the apple on page 244:—

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS, NAMING VARIETIES OF THE CHERRY FOUND MOST SATISFACTORY IN THE COUNTIES.

COUNTIES OF CALIFORNIA.	Early Lamaurie.	Guigne Marbre.	Bauman's May.	E. Purp. Guigne	Belle d'Orleans.	Early W. Heart.	White Tartarian	American Heart	Werder's E. Blk.	Knight's E. Blk.	Rockport Bigar.	Coe's Transpar't	Cleveland Bigar.	Black Tartarian.	Governor Wood.	Ox Heart.....	Elton.....	Black Eagle....	American Amber	Bigarreau.....
Del Norte.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Humboldt.....	.	.	.	.	.	.	.	*	.	*	.	.	.	*	.	.	*	.	.	.
Mendocino	.	.	.	.	.	.	.	.	.	*	.	.	.	*	.	.	*	.	.	*
Lake.....	.	.	.	.	.	.	.	.	.	*	.	.	.	*	.	.	*	.	.	.
Napa	.	.	.	.	.	.	.	.	.	*	.	*	.	*	.	.	*	.	.	.
Sonoma.....	.	.	.	*	.	*	.	.	*	*	*	*	.	*	*	.	*	*	.	.
Marin...	.	.	.	*	.	*	.	.	.	*	*	*	.	*	*	.	*	*	.	.
Contra Costa.....	.	.	.	.	*	.	.	.	.	*	*	.	.	*	*	.	*	.	.	.
Alameda.....	*	.	.	.	*	.	.	.	*	*	*	.	*	*	*	.	*	*	.	*
Santa Clara.....	.	.	*	*	*	.	.	.	.	*	.	.	*	*	*	.	*	*	.	*
San Mateo..... ...	.	.	.	*	.	.	.	.	.	*	.	.	*	*	*	.	*	.	.	.
Santa Cruz	.	.	.	.	.	.	.	.	.	*	*	.	.	*	*	*	.	.	.	.
San Benito.....	.	.	.	*	.	.	.	.	.	.	*	.	*	*	*	*	.	*	.	.
Monterey....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	*	.	.	.
San Luis Obispo.....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.	.	.
Santa Barbara.....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	*	.	.	.
Ventura.....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	*	.	.	.	.
Los Angeles.....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	*	.	.	.	.
San Diego.....	.	.	.	.	.	.	.	.	.	.	.	*	.	*	*	.	.	.	.	.
San Bernardino.....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	*	.	.	.	.
Kern.....	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	*	.	.	.	.
Tulare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fresno.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merced.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stanislaus.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
San Joaquin.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sacramento	.	.	.	*	.	.	.	.	.	*	.	.	.	*	*	*	.	.	.	.
Solano.....	.	.	.	*	*	.	.	.	.	*	.	.	.	*	*	*	.	.	.	.
Yolo.....	*	*	*	.	*	.	.	.	.	*	*	*	.	*	.	.	.	.	.	.
Sutter.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Yuba	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.	.	.
Butte	.	.	.	*	.	.	.	*	.	*	*	*	.	*	*	.	.	.	.	*
Colusa.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.	.
Tehama.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.	.
Shasta	.	.	.	.	.	.	.	.	.	.	.	.	.	*	*	.	.	.	.	.
Trinity	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siskiyou.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.
Modoc.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Sierra.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.	.	.
Nevada	*	*	.	.	.	.	.	.	.	*	.	.	.	*	.	*	.	.	.	.
Placer..... ...	.	.	.	*	.	*	.	.	*	*	*	.	.	*	.	*	.	.	*	.
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Amador.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	*	.	.	.	.
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Mono.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inyo.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS, NAMING VARIETIES OF THE CHERRY FOUND MOST SATISFACTORY IN THE COUNTIES.

COUNTIES OF CALIFORNIA.	Great Bigarreau	Pontiac	Burr's Seedling	Napoleon Bigarreau	Tradescant's Black	Schmidt's Bigarreau	Early Richmond	May Duke	Arch Duke	Late Duke	Reine Hortense	English Morello	Guigne Noir Ie	Belle Magnifique	Cal. Advance	Black Republican	Centennial	Thompson's Seedling
Del Norte																		
Humboldt				*						*								
Mendocino				*				*						*				
Lake								*										
Napa	*	*		*				*	*	*				*		*	*	*
Sonoma				*				*		*	*			*	*			
Marin				*														
Contra Costa				*				*			*			*				
Alameda	*	*	*	*		*		*						*		*		*
Santa Clara	*			*		*		*				*					*	
San Mateo	*			*				*										
Santa Cruz				*	*			*										
San Benito				*	*			*				*				*		
Monterey			*	*	*			*						*				
San Luis Obispo																		
Santa Barbara				*			*											
Ventura												*						
Los Angeles				*				*				*						
San Diego				*						*							*	
San Bernardino																		
Kern				*														
Tulare				*														
Fresno																		
Merced																		
Stanislaus																		
San Joaquin				*				*				*						
Sacramento				*				*										
Solano		*		*	*						*					*	*	*
Yolo								*							*			
Sutter				*														
Yuba				*														
Butte	*					*		*				*				*	*	*
Colusa																		
Tehama																*		
Shasta								*										
Trinity																		
Siskiyou					*			*				*						
Modoc																		
Lassen																		
Plumas								*				*						
Sierra																		
Nevada								*								*		
Placer				*			*					*	*			*		
El Dorado	*											*						
Amador				*				*				*						
Calaveras				*													*	
Tuolumne								*										
Mariposa																		
Alpine																		
Mono				*														
Inyo																		

CHAPTER XIX.

THE PEACH.

THE peach is the leading orchard fruit of California. The number of peach trees was greater than that of any other two fruits combined, but the recent large planting of prunes is changing the relations. The peach was the first fruit to ripen on the improved trees brought here by the early American settlers, and the magnificence of the peach was consequently the key-note of the refrain which greeted the ears of the world in which the California gold cry was ringing early in the fifties. In fact, the gold from the mine and the gold from the tree were very nearly related. In old Coloma, where gold was discovered, there was a peach tree which bore four hundred and fifty peaches in 1854, which sold for $3.00 each, or $1,350 for the crop of one tree, and in 1855, six trees bore one thousand one hundred peaches, which sold for $1.00 each. These pioneer trees are said to be still living and bearing fruit.

LONGEVITY OF THE PEACH IN CALIFORNIA.

There are many other facts to establish the claim that the peach tree, if planted in a suitable soil and situation and cared for with any devotion and skill, is not a short-lived tree in California. California is too young to mark the limits of its duration, but there are numerons instances in the earliest-settled places in the State, where peach trees thirty to thirty-five years old are still vigorous and productive. At the San Jose Horticultural Fair, in 1886, G. W. Tarlton showed peaches from a thirty-year old tree as good as any on exhibition, and Jacob Graves, of the same place, the same year reported a crop of fifteen boxes (about four hundred pounds) from a tree of the same age. W. J. Pleasants, of Pleasants' Valley, Solano County, has peach trees from Kentucky pits planted in 1856. He says he sees no signs of death from old age in the trees; where they show weakness it has resulted from ill treatment.

In favorable soils the peach is stronger and longer lived in the root than in the top, and sometimes triumphs over neglect by discarding its old, wind-broken, sun-burned and bark-bound branches, and forms a new head of its own. This is the reason

why the intelligent system of pruning which is now prevalent ministers to the longevity as well as the profitability of the tree, aiding it to constantly renew its youth by restraining its exuberance, and at the same time furnishing it sound new wood on which to grow its fruits and foliage. But while these are facts, there is some difference of opinion as to the point at which an old tree becomes less valuable than a young one. Along the Sacramento River some count about a dozen good crops as the limit, and thus replace the trees when about fifteen years of age. This is a point which may vary greatly, according to local conditions.

EARLY PRODUCTIVENESS.—Quite as important as the longevity of the peach tree are the facts of its rapid growth and early productiveness. It is the first of our fruit trees to attain size and yield a profitable crop. Actual observations to support these statements are so numerous that it is hard to determine which is the most striking. F. M. Tenny, of San Jose, has five hundred and fifty peach trees, which, in 1886, two and one-half years from time of planting in orchard, matured eleven tons of fruit, which sold at $50 and $55 per ton, and vegetables had been grown between the trees. One tree which was measured was fourteen feet high, twelve and one-half feet in diameter of spread of branches, and ten inches in circumference of trunk. On the place of G. W. Thissell, in Pleasants' Valley, Solano County, the writer saw seventy-five pounds of peaches taken from one three-year-old Muir tree, and one hundred and eighty pounds from one four-year-old Lovell tree. These facts are stated to show what the peach of good variety will do in a good situation and soil and with the best of care. Of course they are not to be taken as average results, although greater than those given are sometimes attained.

LOCALITIES FOR THE PEACH.

Nearly every county in California reports the possession of peach trees. Above a certain elevation on the sides of the Sierra Nevada, they are subject to winter killing, and lower still careful choice of situation has to be made to avoid frosts at blooming-time—the peach in such places being subjected to some dangers which beset it in the Eastern States. Below these points, however, lies the great fruit belt of the foot-hills of the Sierra, where the peach is the chief fruit grown and its excellence is proverbial. Size, beauty, richness, and delicacy of flavor, firmness, which endures carriage to the most distant markets, are all characteristics of the foot-hill peaches of California.

In the great interior valleys of the State wherever proper condition of soil and water supply can be found, the peach also thrives, the tree making a wonderfully quick and large growth, and the fruit attaining great size.

In the small valleys on the west of the great valley and on the eastern slopes of the Coast Range, there are also extensive areas suited to the peach, and sheltered places on the eastern and western edges of the Sacramento Valley have produced the earliest fruit for a long series of years. Recently the contest for the earliest fruit between these districts, the foot-hill district on the east side of the Sacramento Valley and special locations in the upper San Joaquin Valley, has been quite close.

In what is called the coast valleys, the valleys opening upon San Francisco Bay and the Pacific Ocean, the peach is also a leading fruit. Its success is greatest, however, where good shelter is had from direct coast influences. Even where open to these influences, good peaches can be grown by choosing the smaller range of varieties, which do well by protecting the trees from harsh winds, and by seeking elevation above depressed valleys, whose frosts are frequent. The occurrence of curl-leaf is a factor of much importance, which will be considered presently. In the coast counties north of San Francisco Bay the danger to the peach from unfavorable atmospheric conditions increases as one goes northward, and situations must be chosen with greater care. And yet by such exercise of care, peaches for home use and local markets can be successfully grown.

South of San Francisco Bay the coast influences soften as you proceed southward, and the peach draws nearer to the ocean, choosing, however, elevations, and avoiding broad, wind-swept areas and narrow defiles where drafts and fogs are frequent. At considerable elevations, as on the Santa Cruz Mountains, some varieties of peaches are notably excellent. The general rule holds with the peach, as with other fruits, that coast influences retard ripening and the season of the fruit is late.

In the interior valleys of Southern California the peach is largely grown and high excellence attained.

SOILS AND EXPOSURES FOR THE PEACH.

Though the range of soils for the peach can be somewhat extended by the choice of stock for budding upon, as will be considered presently, its range is narrower that that of the apricot. The best peach soils are light, deep, sandy loams, rather dry than moist, but under all circumstances well drained. It will thrive on land with a considerable mixture of course sand or gravel, providing it contain also needed elements of fertility;

for the rapid growth and heavy fruitage of the peach requires abundant nutrition. Though it accepts coarse materials both in soil and subsoil, it relishes fine sediment and perhaps finds no more congenial location than in the deep, sandy loam, or sedimentary deposit bordering the creek beds of our warm valleys, and will send its roots deep to secure long life and abundant fruitage. Such soils, whether along existing streams or deposited by prehistoric water courses, which have left their mark by the elevated ridges of rich sediment above the prevailing valley soils, are warm, deep, and thoroughly drained, and delight the peach.

At elevations on the hillsides there are free loams which result from decomposition of the underlying rocks, and on them the peach thrives, both where the soils themselves are deep and where the underlying rock is loose and open, permeable by roots and affording escape for water. Success has been reported even when holes are partly excavated in these rotten rocks, as in the soft sand rock on the hills east of Vaca Valley, or in the broken chalk rock in what is called Blackburn Gulch, near Santa Cruz. The superior warmth of such soils is supposed to minister to earlier ripening of the fruit, though the escape from cold air by elevation is no doubt a greater factor to the end.

The influence of comparatively slight difference in elevation is very marked. E. R. Thurber, of Pleasants' Valley, Solano County, has a plat of peach trees on a natural terrace about seventy-five feet higher than the general level of his orchard. On the terrace his peaches ripen and are disposed of before the same varieties ripen in the orchard below.

As in the valley a short distance to water is to be avoided, so on the hills too great percolation from higher levels is undesirable. Of course natural defects of this kind can be corrected by adequate under-drainage.

Still, though such be the general soil conditions best suited to the peach, the tree can be well grown for home use or local markets on somewhat heavier soil, providing there is good drainage, but drainage must be insisted upon, for thousands of trees have perished during the last few years because planted in retentive soils without drainage. Alkaline soils should, however, be avoided, as the peach, when grown on its own roots, seems to be of all fruits most sensitive to alkali.

As to exposures for the peach the same rules hold as for other fruits which are liable to injury when in bloom or young foliage. Thus low places where cold air settles should be avoided, also low gulches through which cold drafts prevail. In frosty situations an incline away from the morning sun will often allow the trees to escape serious injury.

PROPAGATION AND PLANTING.

The chapter on propagation gives the general method of growing and budding peach seedlings. In selecting pits, preference is usually given to those from strong-growing, yellow peaches, at least for working on the same colored fruit, while others use pits of the Morris White, others the Strawberry, and others still will use only pits from a vigorous seedling tree, sometimes bringing them from Utah, where seedling peaches are abundant. In this State the peach is usually so healthy and vigorous, the "yellows" is not known, and less care may be needed in selecting pits; still, there is certainly nothing lost by making every effort for a good stock.

Dr. Strentzel, of Martinez, has always strongly recommended the use of the hard-shell sweet almond as a stock for the peach, claiming that it gives a hardier, stronger root, in dry soils especially. His own long experience is in strong support to his position. Other growers have reported success with the stock, Dr. Chapin especially commending it as a stock for the Foster peach.

When it is desired to grow the peach on moister soil than suits its own roots, the St. Julian plum is used. The Myrabolan is also used to some extent, but experience generally does not favor this stock, though commended by some.

The so-called "peach-almond" has been used to some extent. It is a fruit having the pit of a peach but the pericarp of an almond, that is tough and tasteless and disposed to split like an almond hull. Senator Routier, of Sacramento County, reports peach trees budded upon seedlings of the peach-almond, as having smooth, straight stems and fine, spreading tops. Trees bearing the peach-almond are found here and there over the State.

DISTANCE IN ORCHARD.—Distance observed in planting peach orchards differs greatly, according to the views of different growers. Regarding the peach as a catch crop to plant between apricot, pear, cherry, walnut, fig or other slower-growing, larger trees, the trees may be set comparatively close; that is, with the latter trees at thirty to forty feet, and alternate rows of peach planted quincunx, and to be removed at the end of ten to fifteen years. If the peach is to have the ground to itself, some planters plant at eighteen feet in equilateral triangles, or twenty to twenty-four feet on the squares, the present tendency with the peach, as with other trees, being to give more room than was the custom a few years ago.

AGE OF TREES.—In planting peach orchards yearling trees are generally used, although far more are planted in dormant bud than of any other kind of fruit trees. The reason for this is easily found in the disposition of the peach to make a tree the first year from the bud. It springs almost at once into a full outfit of laterals. Some growers, like Mr. Thomas, of Visalia, employ this disposition to form a head the first year in the nursery. When the bud has grown out eighteen inches, he pinches it off at the top and forces out laterals which will grow eight or ten feet the same season. When planted out in orchard the following winter, they are cut back to ten or twelve inches. In this anyone can get a yearling with the equivalent of a two-year-old low head on it. The common practice is, however, to let the growth from the bud proceed as it chooses, and when the yearling is set in orchard, cut back to a single stem twelve to eighteen inches long. This occasions the removal of many strong laterals, and gives a scarred stem on which latent buds must be started out; this, however, is done freely enough. It is to escape this that dormant buds are taken from the nursery, and by this practice the head is grown on the tree in permanent place, and all desired laterals put forth the first year may be made use of.

PLANTING DORMANT BUDS.—The chapter on planting describes the planting of yearling trees. The lifting of dormant buds from the home nursery and planting in orchard is described by P. W. Butler, of Placer County, as follows:—

> Have the ground prepared and stakes placed in position in the orchard in early February, if possible, and begin the planting at once, while the trees are in dormant bud. Take no more trees from the nursery than can be planted in half a day. Plow a furrow on each side of the row, six inches from the trees, turning the soil from them, then two men with heavy spades or shovels, one on each side of the tree, can readily take it up without breaking but few of the roots; but what are so broken should be smoothly trimmed with a sharp knife. Place the trees in a tub of water, near where they are to be planted, and take from it only a few at a time. Put them in a basket or box and cover with wet sack, that they may be kept moist until placed in the ground.
>
> On planting, place the bud one inch below the level of the ground, but do not cover it until after it has grown to the height of a few inches. The stock should be cut off at the bud with a thin, sharp knife, and not with shears, as it is often done, as the latter method will sometimes split the tree, when it will take in moisture and not heal readily.

Some growers do not cut back the young seedling tree until growth has started out well on the dormant bud.

Rather more care is needed in handling dormant buds both in planting and in their young life in the orchard. Lookout must be kept for suckers and against injury in cultivation. The method of shaping a tree from a dormant bud will be given presently. Success with dormant buds is notable. In good

hands they commonly outgrow yearlings planted at the same time, and the percentage of loss from failure of the bud to start is very small. Of course every bud should be examined before planting, to see that it has a healthy color.

In the selection of peach trees for planting, a clean, healthy root only should be taken. During recent years there have been a good many young roots affected with knots or swellings from some obscure cause. Such trees should be burned. If planted, the knot sometimes grows to an enormous size and little or no top growth is made.

PRUNING THE PEACH.

As has been advised for other trees, the peach should be given a low head. In its after treatment, it has been the universal experience that constant "heading in" is essential to the strength and health of the tree. The methods of shaping the tree will be given in the words of two large peach growers, who speak from long experience. Take, first, the more prevalent method, starting with a yearling tree. Hon. L. W. Buck, of Vaca Valley, proceeds as follows:—

In planting yearling trees cut them down to about twenty inches above the ground, then allow only a few of the top buds to grow. The next winter I remove all but three or four or five sprouts; those I cut usually from four or five or six inches long, and as straight across the top of the tree as possible. The object is to have three, four, five, or six branches growing; and the next winter I leave about a foot or fifteen inches. The object is not so much to keep the tree down as it is to stiffen those main limbs that start off from the tree. You will then have a good, stocky, healthy three-year-old tree, ready to commence bearing. Now cut the top back again the next year in the same way, leaving about the same length of new wood, and cut back heavier each succeeding year as the tree grows older. A great many make the mistake of trying to get peaches from trees too young, and in so doing leave too much wood; as a consequence, when the tree is four years old it is ten feet or more high, and the cutting back then has to be done and the grower loses the most of a crop worth a great deal more than the one he gains from the two-year-old tree. There is no danger of pruning a peach tree too much. Cut off nine-tenths of all the new wood and you will then have to thin your peaches. In pruning bearing trees I leave from four to eight inches of new wood, taking care to leave this on the largest, healthiest growth (as the largest limbs invariably produce the finest peaches), and cutting out unnecessary and decayed limbs. In this State nearly all, if not all, varieties of peaches are inclined to overload, and it is only by very thorough pruning and thinning out that a peach tree will remain vigorous and produce a crop of fruit every year.

There is an error that is practiced by orchardists, that is, in cutting off all the inside branches as the limbs grow up, and after a few years you have quite a long limb with no lateral branches. If you will retain the lateral branches, you can cut back to four or five, or six or eight, inches, and still you do not cut it far enough to get a dead limb, the sap of which will eventually run down into the heart of the tree and kill the tree.

This retention of bearing shoots low down in the tree is of the greatest importance. Leonard Coates, of Napa, describes it in this way:—

SIX-YEAR-OLD PEACH TREES: ORCHARD OF A. T HATCH, SUISUN VALLEY.

The peach requires a totally different method of treatment after it commences to bear than the apple or pear, for, as it bears only on one-year-old wood, the fruit buds for the coming season being formed while the fruit is still on the tree, cutting back must be more severe, as the growth of new wood diminishes. Not more than five or six fruit buds should be left on a shoot, and if the fruit all sets, it must be also thinned. The trees should be trained low and their vigor encouraged by permitting a reasonable amount of young shoots to grow around the lower part of the main limbs. When this method is continued systematically every season, the trees will bear large crops of fruit, of good quality, for many years. When they are allowed to overbear for one or two seasons, the fruit will decrease in size, and soon become almost worthless; the trees will be enfeebled, and in consequence very liable to be attacked by disease. The only thing to be done in this case is to cut off the whole top of the tree, allowing it to form a new head. I have seen old peach orchards thus renovated, and the results are often very flattering, but it is far better not to allow them to get into a condition where this desperate remedy is necessary.

PRUNING, PINCHING, AND SHAPING.

P. W. Butler, of Penryn, Placer County, has the reputation of owning a peach orchard which for uniformity, symmetry, and general excellence of the trees, is not excelled in the State. He starts with dormant buds, as already stated, and his method may be acceptable to those who desire to secure perfection of form in their trees, and are willing to take the trouble to secure it. Mr. Butler's practice is as follows:*

As soon as trees which were planted in dormant bud have grown to a height of about two feet, their tops should be cut off at a height of eighteen inches from the ground, or at a bud or limb near that point. Cut all the buds from the lower part of the tree, leaving five or six near the top from which to select, later, those to be used to form the head of the future tree. Some of them at this time may not have grown to a sufficient height to allow of their tops being cut, and they should be examined every two weeks until this is done. When the limbs have grown to the length of a few inches, select from three to five and pinch off the ends of all others. It is better to do this than to remove them entire, as this would lessen the capacity of the tree to take nourishment from the air.

When the limbs that are permanently to remain have grown to a length of fifteen inches, pinch off their ends, and those that are not growing in a proper direction can be brought into position and kept there by passing around them a band of cloth one-half an inch wide, and fastening to a stake set by the side of the tree and extending above it about one foot, drawing the limbs upward or downward, as desired. They can also in this way be made to grow at equal distances from each other around the tree, and care must be taken that the limbs continue to grow straight and at the right degree of inclination throughout the season, and all other growths pinched or cut back to within a few inches of the tree.

At any time when convenient during the following late autumn, winter, or early spring, the trees may receive their first regular pruning. Carefully note the direction the limbs have taken in their growth, and when they incline too much downward, cut them off to a bud that is growing from their upper side; but if they incline too much to a perpendicular, cut to buds growing from the lower sides. If it is desirable to remove any of the upper limbs, cut them off close to the next lower one, never leaving a growth in the center of the tree. In case the spaces between the limbs are not equally divided, cut to buds growing from the sides where the distance between the limbs is the greatest By pursuing this course the tendency will be to direct the growth to desired equilibrium. When the limbs are large, they should be cut to a length of about fifteen inches, but less when they are small; and cut off all side limbs and all other growths entire.

**Pacific Rural Press*, Feb. 28, 1885.

The following summer after the new limbs have grown to the length of a few inches, select three of the upper ones if the tree has three branches of last year's growth, or two if the tree has either four or five branches of the older growth, and pinch back all other limbs, and continue to keep them shortened through the season. Each tree will now have for a permanent growth either eight, nine, or ten new limbs, and when they have grown to the length of a foot or more, take a hoop made from old bailing wire that is doubled and twisted, and fifteen to eighteen inches in diameter, and place it over the top of the tree and put all limbs that incline downward on the inside of the hoop, and all others on the outside; then move the hoop up or down until it is in the position to give just the right inclination to all the limbs, and arrange them at equal distances from each other, and if necessary to keep them in place tie with bands of cloth, but not so tight as to interfere with their growth. See that all the trees are, throughout this season, kept in perpendicular position, or, better still, a little inclined to the direction from which comes the prevailing winds, as after this year the tree will have become so large and the roots so firmly imbedded in the ground that its position cannot be easily changed. Keep the limbs growing as straight as possible in the direction of thirty three degrees from a perpendicular, and when two feet long pinch off their ends, and by the end of the growing season they will have become so large and strong as to need no further training of this kind, and the outline of the future tree will be beautifully and permanently formed.

At the second pruning cut all the new limbs to a uniform length of eighteen inches perpendicular height, varying from this only when the tree is larger or smaller than the average. The trees will now be three and one-half feet high, or a little more, and each will have from eight to ten limbs of the latter growth, with some lateral branches, a portion of which may be shortened and retained, but remove all the growth on the limbs of the first season. Assist the trees to keep an upright position. For the third year is wanted two or three branches of the new growth on each of the old limbs, and continue to pinch back all other growths. When the new limbs have grown to a length of twenty-five or thirty inches, pinch off their ends, as a growth beyond that is not needed.

At the third pruning cut the new limbs to a perpendicular height of two feet from the last cutting, and the laterals, when growing too far on the outside or inside of the tree, must be properly shortened, and when growing too near each other, or are imperfect, they must be removed. Always cut off a limb so that the acute angle of the cut shall come just above and close to a bud or limb; the new growth will then soon cover the cut and obliterate all signs of the wound; while, if the limb is cut so that a portion extends beyond a bud, it remains to decay or afterwards be removed by the knife. The tree after it is pruned will now be five and a half feet high. During the following season again allow only two to three branches to grow on each of the older ones, and pinch off the ends of these when they have grown to the height of twenty-five or thirty inches, and also pinch back the longest-growing side limbs, and remove them entirely when it is thought they will not be wanted for fruit bearing for the next year.

At the fourth pruning again cut to leave the late growth two feet high and the top of the tree flat, leaving the small lateral growth only extending above. Steps two and a half to three feet high are now needed, and they can be made from light lumber at little cost. The eye of the person pruning, when standing on the top step, should be a little above the level of the point where the limbs are to be cut, and with care the top of the tree can then be easily made level. Thin out the light growth to uniform distances, and remove or shorten outside branches that the tree may be kept in an exact symmetrical form. From the lower limbs cut the water sprouts and all dead or imperfect branches. The trees are now seven and a half feet high, and the following summer should have a crop of fruit that will bear down the outer branches, exposing the fruit to the sun, that will give it color and flavor, while it can nearly all be reached from the ground by a man of average height without the aid of a ladder. By this system of training there is little danger of the limbs breaking or needing support, even if heavily laden with fruit. The growth of this season will cover the top of the bowl-shaped center of the tree, and the fruit can be more readily reached than from a tree grown in the usual irregular form.

After this season the yearly growth will be much less, and only the longest limbs will need cutting back, but the thinning and removing of all imperfect limbs must be continued as heretofore.

These methods of precise training may be thought unnecessary, yet it is well known that most people take a much greater interest in caring for anything they produce that has unusual superiority. The tree that is perfect and uniform in its growth will bear fruit that is correspondingly perfect and uniform, and an orchard that should be in fruiting many years will pay for the extra expense incurred in this system.

THINNING PEACHES.

Thinning out fruit on the peach tree is not only the secret of obtaining good, marketable fruit, but joins hands with pruning in preserving the health and future production of the tree. Young peach trees on good soil have really borne very heavy crops for a few years and have so overtaxed their own powers that wood growth is almost entirely checked. Sometimes, as Mr. Coates has said, in a quotation just made, the tree gets into such condition that its vigor can only be restored by beheading in the winter and forcing out new wood. The secret is to allow the tree to retain as much fruit as it can bring to large size, without preventing a healthy growth of new wood.

Thinning should not be done until the fruit has well set, for sometimes conditions occur which cause much young fruit to drop. When this danger is passed, the fruit should be hand-thinned, not knocked off with poles, as is sometimes done. All double or triple fruits should be removed; one peach at a bud is enough. Growers differ as to distance between fruits: some instruct the thinners not to leave them nearer than a hand's breadth to each other; others make the distance greater. Some growers have an estimate of what the yield should be according to the age of the tree, and thin down to it as closely as possible. F. B. McKevitt, of Vaca Valley, endeavors to reduce four-year-old trees to four twenty-five-pound boxes each; five-year-old, five boxes; six-year-old, six boxes, etc.

Not only is thinning of vital value to the tree, but the increased market value of the improved fruit far more than covers the cost of thinning.

WORKING OVER PEACH TREES.

The fashion in peaches changes from time to time according to the demands of the canners or the market for dried fruit. The grower often finds varieties which he first selected, less healthy, less productive, or, for other reason, less desirable than others. There is, therefore, often occasion for working over trees. This is often done by ordinary methods of top grafting, and with good success. Budding is also resorted to, buds being successfully set in quite old wood, providing buds from well-

matured wood are taken. Wood buds from young trees unaccompanied by fruit are best, but because of greater certainty of securing the variety desired, it is common to take wood and fruit buds together from bearing trees. A larger cut of bud and adjacent bark is taken when working in old bark than for use on seedlings. When a branch is budded, it is sometimes broken at a distance beyond the bud and allowed to hang, the idea being to furnish the bud some but not too much sap. Some growers thus bud and break part of the branches, allowing others to remain unworked, to maintain the growing processes of the tree. These branches and those in which buds have not taken, are cut off and grafted the following spring. The almond is successfully grafted over with the peach, and this course has been followed with thousands of unproductive Languedoc almonds during the last ten years

DISEASES OF THE PEACH.

CURL LEAF.—The most prevalent trouble with the peach tree in California is the curl-leaf. It was noticed from the first planting of peach trees by Americans, nearly forty years ago, and has been a subject of discussion ever since, and but few things are definitely settled about it. Its cause is still obscure and always a bone of contention between peach growers. The abnormal growth has been traced to parasitic fungi, and washes of fungicidal character have had a good effect when applied early enough, that is, in the winter before the leaves appeared. The "copper-lime" mixture, which will be described in the chapter on grape diseases, has had a good effect. Thus far, however, most has been accomplished by avoiding the disease. Fortunately, enough has been ascertained to enable the peach grower to do this. The facts may be stated as follows:—

Curl-leaf is much more prevalent in some sections than others, and in one place than another in the same section. Some varieties are much more subject to curl-leaf than others; generally speaking, some curl nearly everywhere, others curl in one place and not in another, others are practically free from curl in all situations.

The lesson from these facts is that curl-leaf must be studied locally, and that the selection of varieties must be made with greater or less care, according as the location is subject or comparatively free from the trouble. Nor can decision be given for wide areas, generally, because special places often differ greatly, even though within sight of each other. So far as the writer has data for generalization, it may be set down—

First—That direct coast influences favor curl-leaf, the injury diminishing from north to south.

Second—That, in interior and foot-hill valleys, low places, where damp, cold air settles, or cold drafts prevail, favor curl-leaf, even when slight adjacent elevations are comparatively free from it.

Third—That the river bottom-lands of the San Joaquin Valley favor curl-leaf, while on the great plains it is of rare occurrence.

The foregoing considerations are geographical. Other conditions intrude, viz.:—

Fourth—That the peculiar weather conditions regulate the prevalence of the trouble; some years the disease is hardly noticeable, even in regions most favoring it.

Fifth—That in some regions usually free, unseasonable warmth in winter sometimes induces too early leaf growth, and curl follows.

Curl-leaf occurs in various degrees. Mild cases do not seem to injure either tree or fruit; severe cases destroy the fruit and sometimes the tree itself. The disease is always at its height about when the young fruit is about the size of small peas. If the curl is "bad," the fruit will fall to the ground, there not being healthy leaves enough to afford the required support. If, however, the curl is moderate and partial, only a part and sometimes none of the fruit will be lost. The disease, as is well known, is of brief duration, say twelve to twenty days, after which the trees resume a healthy appearance in every respect, and if the fruit has been able to survive the ordeal, it also appears to grow and become as perfect as if no check had been given to its growth.

When trees are known to be subject to curl-leaf, it is better not to prune them until after the disease has run its course.

LOCAL OBSERVATIONS ON CURL-LEAF.—The following review of occurrences of curl-leaf, according to location, names those varieties which do not curl enough to endanger their fruit. The record is by counties.

PEACHES NOT INJURED BY CURL-LEAF.

HUMBOLDT.—Early York, Orange Cling, Briggs' May, Old Mixon, Early Tillotson. "In cold, northerly rains all varieties curl more or less."

MENDOCINO.—"All varieties are affected by curl to some extent."

LAKE.—Alexander, Hale's Early, Early Crawford, Early Tillotson.

NAPA.—Alexander, Hale's Early, Early Crawford, Snow, Susquehanna. "Some years nearly all kinds curl."

SONOMA.—Amsden, Alexander, Early York, Early Crawford, Honest Abe. "Late varieties curl least; clings curl least."

CONTRA COSTA.—Alexander, Early Crawford, Snow, Smocks.

ALAMEDA.—Amsden, Alexander, Briggs' May, Early York, Early Crawford, Foster, Richmond, Honest Abe, Mary's Choice, Susquehanna, Salway.

SANTA CLARA.—Amsden, Early Crawford, Foster, Stump the World. "All are affected after a wet winter, particularly when there are heavy late rains."

SAN MATEO.—Many varieties are affected.

SANTA CRUZ.—Briggs' May, Hale's Early, Early Crawford, Honest John. "The earliest freestones and late Crawford are freest from curl, but the disease on Pajaro Valley lands does not seem to disturb the yield of the tree or size of fruit."

SAN BENITO.—Nearly all kinds curl in a bad year. "Late clingstones curl least."

MONTEREY.—All curl more or less in "curl seasons."

SAN LUIS OBISPO.—Briggs' Red May, George the Fourth, President, Early York, Early Crawford.

SANTA BARBARA.—Early Crawford, Lemon Cling. The Strawberry only curls in bad years. "I can see very little difference in varieties." Late varieties curl least.

VENTURA.—Briggs' May, Hale's Early, Early Tillotson, Late Crawford.

LOS ANGELES.—Amsden, Alexander, Briggs' May, Early York, Hale's Early, Early Crawford, Late Crawford, Coolidge's Favorite, Smock, Salway, Lemon Cling, Heath Cling.

SAN DIEGO.—Amsden, Early Crawford, Early Tillotson, Strawberry, Foster, Salway, Ward's Late, Smock, December Cling. "Very little trouble with curl-leaf."

SAN BERNARDINO.—"Curl-leaf rarely is seen and affects but few varieties."

KERN.—"No curl-leaf here."

TULARE.—"But very little curl-leaf in this region." "Have no curl on any variety tried."

FRESNO.—"No curl known here."

MERCED.—"Never had any curl-leaf."—Merced. "Some years curl-leaf destroys the fruit and almost kills the trees."—Snelling. The latter situation is on river bottom-land.

STANISLAUS.—"Curl-leaf affects many varieties, but it seems to interfere but little with fruiting."

SAN JOAQUIN.—Early Crawfords, Hale's Early, Foster, Susquehanna, Smocks, Free, Newington Cling.

CALAVERAS.—Briggs' May, Alexander, Hale's Early, Parson's Early, Early Crawford, George's Late.

SACRAMENTO.—Alexander, Early Crawford, Heath's Cling, Smocks, Late Free, Honest Abe, McIntire's Late Free.

SOLANO.—Alexander, Early Crawford, St. John, Strawberry, General Grant, Mary's Choice, Susquehanna, Salway. "All varieties are free from curl seven years out of eight, and curl does not appear even on sensitive varieties at an elevation of one hundred feet above level of water courses."—Pleasants' Valley. "Never had curl here."—Putah Creek.

YOLO.—Briggs' May, Parson's Early.

YUBA.—Briggs' May, Hale's Early, Early Crawford, Late Crawford, Texas Ranger, Smocks.

BUTTE.—"This locality is quite free from curl-leaf."—Chico. "Occasionally a year in which there is considerable curl-leaf."—Oroville.

COLUSA.—"Never saw any curl-leaf in my orchard."—Williams. "Some varieties curl badly."—Colusa.

TEHAMA.—"Curl only seldom appears."

SHASTA.—Strawberry, Early and Late Crawfords, Orange Cling, Smocks, and two unnamed seedlings.

SISKIYOU.—Early Crawford, Early York, "Squire Gross," "Cox' Cling," "Campbell's Seedling." "Curl-leaf is not sufficient to hurt fruit."

PLUMAS.—"No curl-leaf noticed." Only middle season varieties are grown.

NEVADA.—Hale's Early.

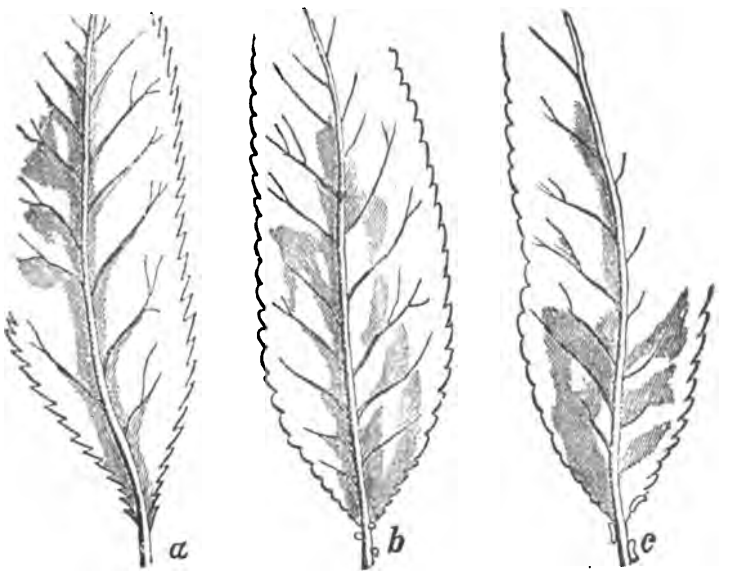
PLACER.—Briggs' May, Alexander, Hale's Early, Early Crawford, Foster, Lemon Cling, Salway, Wood's Cling, Day's Yellow and White Free and Cling, Picquet's Late, George's Late, Jones' Seedling, Salway, Smocks. "Curl-leaf is rarely seen and follows late, cold, wet weather."

EL DORADO.—Crawford, Orange Cling. "Nearly all varieties are subject to curl when the spring is wet and cold; sloping hillside is necessary to success."

AMADOR.—Early Crawford, General Grant. "All varieties subject to curl, but early varieties seem less in danger." "Peaches suffer most in wet seasons." "Trees on hillside suffer less than on bottoms."

TUOLUMNE.—"Curl-leaf is prevalent and affects nearly all varieties some years."

MILDEW.—This disease, which occurs in the form of whitish felted patches on leaf and twig early in the spring, and finally affects the fruit, has long been troublesome in this State, and occurs on certain susceptible varieties in many localities from the coast to the Sierra foot-hills. Observation in this State has



CHARACTERS IN THE LEAVES OF PEACHES.

fully affirmed the statement of Downing, that the serrate, glandless-leaved varieties are liable, and those with good glands on the leaf stems are free. The engraving, reproduced from Downing, explains what is meant by these terms.

"At the base of the leaves of certain kinds are always found small glands, either round and regular or oblong and irregular, while the leaves of certain other kinds have no glands, but are more deeply cut or serrated on the margin. These peculiarities of the foliage are constant, and they aid us greatly in recognizing a variety by forming three distinct classes, viz.: 1. Leaves serrated and without glands, *a*. 2. Leaves with small, round, or globose glands, *b*. 3. Leaves with large, irregular, reniform glands, *c*."

The conclusion would be that where mildew prevails, varieties with serrate, glandless leaves should be avoided. But it has been found that some glandless-leaved varieties, although subject to mildew, resist curl-leaf. Therefore it may be worth while to combat the mildew. This has been effectually done by thoroughly sulphuring. Mr. Klee advised three applications where mildew is apt to be bad, the first one very early in the season. It has been found that the winter spraying of the tree with washes containing sulphur for scale insects and peach moth, has also reduced the mildew.

As with curl-leaf, mildew is prevalent some years and slight in others.

VARIETIES OF THE PEACH.

Nearly all varieties of the peach have been tried in California, and, as with other fruits, it has been found that varieties must be chosen with reference to their success in special locations. Choice has also been made according to the purpose of the grower, whether for early marketing, for sale to canners, for drying, for distant shipment, or for late marketing. As with apples, there is little use of planting early varieties (unless it be for home or local use) except in very early regions. An early peach from a late region is killed by competition with better middle season sorts from the earlier regions.

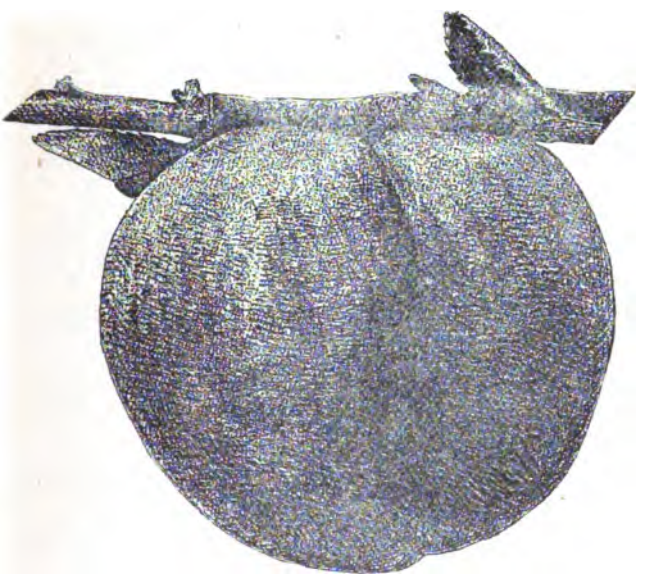
In an early region one can plant early, middle, and late varieties to advantage, and thus secure a very long fruiting season. The peach season in Vacaville district begins at the first of June with the Alexander, and continues to the end of November with local seedlings—giving six months of peaches. Of course the very early and very late sorts are only of use for marketing as table fruit. The most important series is a fine succession of mid-season peaches, suitable either for canning, drying, or distant shipment. Such a selection can be made from the tables and descriptions which will be given later.

Color is a most important item in the peach. While canners and Eastern shippers use the beautiful white peaches to advantage, the fashion for drying is now strong in support of

the yellow-fleshed varieties, and as drying promises to be our widest avenue of profitable disposition of the peach, the yellow peaches are in greatest demand. The color about the pit is also an important point. Canners demand a peach, whether white or yellow, which is almost free from color at the pit, because the extraction of the red color dyes the juice; in drying, the demand just now is for a yellow peach with a red center, because the colors give the dried fruit a more attractive appearance. Of course there is a market for dried white peaches, but the preference is for the yellow.

The following are the peaches chiefly grown in California, arranged approximately in the order of ripening:—

BRIGGS' RED MAY.—(California.) Originated as a chance seedling in nursery row, on the farm of John G. Briggs, on the Feather River, about one mile from Yuba City, about 1870. It was found to be about ten days earlier than the Early Tillotson, which was then the stand-by for an early peach. Fruit medium to large, round; white skin with rich, red cheek; flesh greenish white, melting, juicy, rich, firm enough for shipment; stone partially free; a standard early variety; subject to mildew. (See table.)



THE ULATIS PEACH—A CALIFORNIA SEEDLING.

ALEXANDER.—(Illinois.) Most widely grown as best early variety. Fruit medium to large; greenish white, nearly covered with deep red; flesh firm, juicy, and sweet; bears transportation well; pit partly free. (See table.)

NOVALIS.—(California.) A seedling of Peen-to, or saucer peach, probably hybridized. Originated with S. M. Gass, of San Diego. Medium size, roundish, or

slightly oblong; skin yellowish white with faint blush; flesh white, tender, juicy, fine flavor, with little of the *noyeau* taste of its parent; freestone, pit small; tree vigorous, willowy to growth and foliage; blossoms through midwinter; ripens with Alexander, to which it is superior in flavor; bearing qualities not fully determined; propagated by Chapin & Meeker, Poway, San Diego Co., Cal.

AMSDEN.—(Missouri.) Resembles preceding, but averages smaller; claimed by some to be slightly earlier; rather less liable to curl-leaf.

ULATIS.—(California.) Originated near Vacaville, and supposed to be seedling of Alexander, which it is claimed to excel in size, smoothness of skin, firmness and beauty, and may be a few days earlier; propagated by Leonard Coates, of Napa. Approved in Solano County.

BAKER'S EARLY.—"Large, pale yellow, blotched with red."—I. H. Thomas.

WATERLOO.—(New York.) Medium to large, round; pale green, marbled with red; flesh adhering partially to pit, greenish white, juicy, vinous. Not largely grown.

EARLY BEATRICE.—(English.) Small, handsome; quality good; small to sell well; ripens several days after Alexander; adheres partially.

GOVERNOR GARLAND.—Large ("averaging seven and one-half inches in circumference"—John Bidwell); color rich, rosy hue; flavor delicious, and fragrance exquisite. Best quality of early peaches; adheres partially; approved in Solano, Butte, and Mono Counties.

EARLY RIVERS.—(English.) Large, pale straw color with blush cheek; very juicy and sweet; too tender for long shipment; freestone. Approved in Yolo, Solano, Los Angeles, and San Diego Counties.

EARLY IMPERIAL.—(California.) Originated by W. W. Smith, Vacaville, by grafting Crawford's Early into a tree of Yellow St. John, planting pits from this double tree in expectation of obtaining a chance hybrid combining size and earliness of two parent varieties. This one of hundreds of seedlings showed these characters and is believed to be the earliest yellow freestone variety known. Fruit large, deep yellow with dark red cheek; flesh rich, very firm; tree free from curl. According to I. H. Thomas, of Visalia, it ripens two weeks ahead of Crawford's Early, and about the time of Hale's and Parsons' Early. Introduced in 1891 by W. W. Smith, of Vacaville, and I. H. Thomas, of Visalia.

YELLOW ST. JOHN.—(New Orleans.) Earliest yellow peach; averages smaller than Yellow Crawford, but classed as large; roundish, orange yellow with deep red cheek, juicy, sweet, and high flavored; freestone. Approved in Solano, Placer, and Fresno Counties.

HALE'S EARLY.—(Ohio.) Medium to large, nearly round; skin greenish, mostly covered and mottled with red when ripe; flesh white, melting, juicy, rich and sweet; fair for local market and shipping; widely grown; freestone. (See table.)

PARSONS' EARLY.—(California.) "Medium size, white flesh with red cheek resembling Hale's, and ripening about same time; freestone."—J. A. Anderson. (See table.)

EARLY TILLOTSON.—(New York.) Medium size, round; pale, yellowish white dotted with red and dark red in the sun; flesh white, melting, juicy and rich, adhering partially to the pit. Subject to mildew but free from curl-leaf. Reported a short-lived tree by some growers. (See table.)

STRAWBERRY.—(New Jersey.) Medium size, oval; stem cavity deeply sunk; suture extending half way round; skin almost wholly marbled with deep red; flesh whitish, juicy, rich and delicate; tree healthy. (See table.)

LARGE EARLY YORK; syn. *Honest John.*—(New York.) Above medium, roundish; skin whitish, clear rich, red cheek in the sun; flesh greenish white, tender, melting, juicy, rich; freestone; does not curl. (See table.)

GROSSE MIGNONE.—(French.) Large, roundish, greenish yellow, mottled with red; flesh yellowish white, melting, juicy and high flavored and delicious; freestone. Approved in Butte, Santa Clara, and San Bernardino Counties.

RED RAREripe.—Rather large, globular, broad and depressed; suture broad and deep, nearly around the fruit; skin nearly white with red dots in the shade, and rich dark red cheek; flesh whitish, red at pit, from which it parts freely; somewhat subject to mildew. Approved in Lake and San Bernardino Counties.

EARLY ANNE.—(English.) Small, round, white, with faint red cheek; flesh white to the stone, soft, melting and pleasant; flowers large, nearly white; subject to mildew. Approved in Amador County.

AMELIA.—(South Carolina.) "Large; white flesh, rather dry; small pit; dries and ships well."—I. H. Thomas, Tulare County. • Ripens before Foster. Approved in Sonoma and Tulare Counties.

PARKER; syn. *Wallalu.*—(California.) Seedling of Crawford's Early in orchard of J. C. Parker, near San Diego, about 1885. Large, oblong, swollen; skin remarkably clear, transparent, and free from down, yellow with dark red cheek; flesh yellow, red at pit, fine grained, juicy, and high flavored; freestone, sometimes adhering very slightly; ripens with, or a little earlier than, Foster; tree vigorous, stocky in growth, a good bearer. This variety is very popular in San Diego and has sold high as table fruit. Propagated by Chapin & Meeker, Poway, San Diego County.

FOSTER.—(Massachusetts.) Uniformly large, slightly flattened; slight suture; stem moderately depressed; flesh yellow, very rich and juicy; color deep orange, dark red in the sun; freestone; tree hardy and productive; very widely grown in California and popular. Ripens before Early Crawford, which it somewhat resembles, but is of better quality. (See table.)

DAY'S YELLOW FREE.—(California Seedling.) Large, yellow flesh, cheek tinted with red; good market variety; ripens with Foster and closely resembles it. Approved in Placer, Amador, and San Joaquin Counties.

CRAWFORD'S EARLY.—(New Jersey.) Very large, oblong, swollen, point at the top prominent, suture shallow; skin yellow with red cheek; flesh yellow, rich, and excellent; freestone; tree very healthy and productive; probably the most largely planted variety in California. (See table.)

GEORGE THE FOURTH.—(New York.) Large, round, deeply divided by broad suture; sides unequal; skin pale yellowish white, dotted with red and red cheek; flesh pale, red at pit, from which it parts freely; quality good. Somewhat troubled with curl-leaf. (See table.)

ROYAL GEORGE.—(European.) Large, globular, broad and depressed; suture deep and broad, extending around two-thirds of the fruit; skin pale or white, sprinkled with red dots and deep red cheek; flesh whitish, but very red at pit; juicy, rich, high flavor; leaves serrate glandless; subject to mildew. Approved in Santa Barbara County.

RICHMOND.—(New York.) Large, roundish, slightly compressed; suture slight but distinct to apex, which is a little swollen; flesh yellow, red at the pit, from which it parts; quality good; ripens just after Early Crawford; tree healthy. Approved in Alameda and Santa Barbara Counties.

SNOW.—(American.) Large, globular; skin thin, clear, beautiful, almost wholly white; flesh white to the free stone, juicy, rich and sprightly. Approved in Napa, Contra Costa, Amador, and San Benito Counties.

MARY'S CHOICE.—(New Jersey.) Large, yellow, resembling Early Crawford, but ripening later. Approved in Alameda, Butte, Santa Clara, and Solano Counties.

RED CHEEK MELOCOTON.—(American.) Large, roundish oval, swollen point at top; yellow, with deep red cheek; flesh yellow, red at stone, which is free; juicy, good flavor. Approved in Humboldt and San Benito Counties.

BERGINS' YELLOW.—(New York.) Very large, globular, depressed and broad; suture well marked; deep orange, with rich, red cheek, with faint streaks; flesh deep yellow, red at pit, juicy, melting, vinous; freestone. Commended as a market peach by Southern California Nurserymen's Association. Has been dropped in the northern part of the State. (See table.)

TUSKENA.—(Alabama or Mississippi.) Wrongly called "Tuscan" and "Tustin" Cling in this State; largely planted in interior valleys and foot-hills; very large yellow cling; the earliest fine cling variety; very valuable for early shipping. Lately introduced and not widely tested, but promises well as a hardy, strong grower; ripens with Crawford's Early. Mostly grown in upper Sacramento Valley and foot-hills; approved in Los Angeles County.

GATES' CLING.—(California.) Originated with J. W. Gates, Vacaville. Color silver white, beautifully tinted with red; flesh white and firm; flavor delicate; pit irregular, but averaging large; size large, good specimens averaging one-half pound; tree very tender and subject to all ills affecting the peach, but thrives well only on first-class soil and under favorable conditions; fruit not good for long distance shipment, but cans splendidly if fresh from the tree. Awarded a silver medal at Mechanics' Fair of 1883. Grown in Vaca Valley.

SHINN'S RARERIPE.—(California.) Originated with James Shinn, Niles. Large; very dark red, almost purple; flesh white, red at the stone, sweet and rich; tree thrifty and free from curl. Ripens just after Crawford's Early. It is a good market peach.—L. W. Buck. Freestone. Approved in Fresno County.

REEVES' FAVORITE.—(New Jersey.) Large, roundish, inclined to oval, with swollen point; yellow, with red cheek; flesh deep yellow, red at pit, which is free; juicy, good; popular for market and quality. Approved in Solano and San Bernardino Counties.

DAY'S WHITE FREE.—(California.) Large; white flesh with red cheek. Approved in San Joaquin County.

DAY'S YELLOW CLING.—(California.) "Very large, red cheek, flesh yellow, good market variety."—W. R. Strong & Co. Approved in Yolo and Placer Counties.

OLD MIXON FREE.—(American.) Large, roundish or slightly oval; greenish or yellowish white, marbled with red; flesh white, tender, and excellent. (See table.)

OLD MIXON CLING.—(English.) Large, whitish with red cheek; flesh white, juicy and rich; high flavor; one of the best clings. Approved in Sonoma and San Diego Counties.

CHINESE CLING.—Very large, oblong; creamy white beautifully mottled; flesh white, juicy, and of high flavor. (See table.)

HONEST ABE.—(California.) "Originated at Healdsburg, Sonoma County. Large, yellow with red cheek; best quality; ripens between Crawford's Early and Late. Does not curl."—James Shinn. (See table.)

MORRIS WHITE.—Large, oval; skin white with creamy tint when fully ripe; flesh white to the stone, which is free; melting, juicy, sweet, and rich; especially good for home use and canning; somewhat subject to curl-leaf. (See table.)

LORD PALMERSTON.—(English.) Very large, whitish, with pink cheek; flesh firm, yet melting, juicy, and rich; grown for shipping by W. W. Smith, of Vacaville. Reported favorably also from Tulare and Placer Counties.

WAGER.—(New York.) Lemon yellow tinged with red; flesh yellow, rich, juicy, sweet, and excellent, having much the appearance and flavor of apricots; stone small and free from the flesh; quality best. (See table.)

MUIR.—(California.) Originated as chance seedling on place of John Muir, near Silveyville, named and first propagated by G. W. Thissell, of Winters. Fruit large to very large; perfect freestone; flesh clear yellow, very dense, rich and sweet; pit small; tree a good bearer and strong grower, if on rich soil, to which it is best adapted; free from curl in Vacaville district; fruit a good shipper and canner and peculiarly adapted to drying because of exceptional sweetness and density of flesh; yield, one pound dry from less than five pounds fresh. One of the best California seedlings. Claimed by some to be identical with Wager. (See table.)

WHEATLAND.—(New York.) Large, roundish; skin golden yellow, shaded with crimson; flesh yellow, rather firm, juicy, sweet, and of fine quality. (See table.)

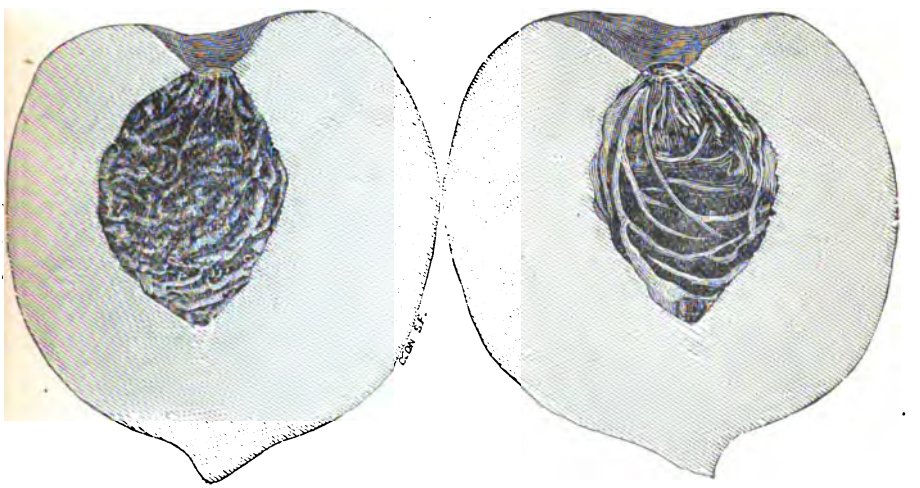
LARGE WHITE CLINGSTONE.—(New York.) Large, round, suture slight; swollen point at apex small; skin white, inclining to yellow when ripe, dotted with red and red cheek. Approved in Santa Cruz County.

NEWHALL.—(California.) "Originated with Sylvester Newhall, of San Jose. Very large; skin yellow, with a dark red cheek; flesh deep yellow, juicy, and a rich vinous flavor; ripens about one week before Crawford's Late; tree very hardy, healthy, vigorous, and not affected by curl; freestone."—John Rock, Santa Clara County.

STUMP THE WORLD.—(New Jersey.) Large, strong; skin creamy white, with bright red cheek; flesh white, juicy, and high flavored. Commended for family use by Southern California Nurserymen's Association. Curls somewhat in some localities; freestone. (See table.)

CRAWFORD'S LATE.—(New Jersey.) Very large, roundish, yellow with dark red cheek; flesh deep yellow, juicy, and melting; flavor rich and excellent; a popular and widely-grown variety, but very subject to curl-leaf in some localities; freestone. (See table.)

THISSELL'S FREE.—(California.) Originated with G. W. Thissell. A large white peach with light red cheek; flesh juicy, rich, and white to the pit; quite widely distributed.



THE MUIR PEACH—A CALIFORNIA SEEDLING.

FLORIN.—(California.) "Very large; yellow, free, ripens with Late Crawford, but superior in size and flavor; tree hardy, rapid grower, does not curl."—Robert Williamson.

LEMON FREE.—(California.) Originated on Rancho Chico as chance seedling. Bright yellow, freestone, lemon-shaped, and resembling Lemon Cling in size and color; clear yellow to pit; very juicy, exceedingly thin-skinned, therefore unfit for market, but excellent as fancy variety for home use; very beautiful when canned.

LEMON CLINGSTONE.—(South Carolina.) Large, lemon-shaped or oblong, having large, projecting, swollen point like a lemon; skin fine yellow; flesh firm, yellow, with rich, sprightly, vinous subacid; slightly red at the pit, which adheres firmly. (See table.)

BAXTER'S CLING.—(California.) "Originated in Placer County and propagated by William Baxter. Very good; similar to Orange Cling, but earlier."—P. W. Butler.

ORANGE CLINGSTONE.—Large, round; suture distinctly marked and extending nearly around the fruit; no swelling at apex, like Lemon Clingstone; deep orange color, with red cheek; flesh yellow, firm, juicy, with rich flavor; somewhat subject to mildew. Though largely grown, this variety has been largely supplanted by the following sub-varieties, which are seedlings from it. (See table.)

SELLERS' GOLDEN CLING.—(California.) Originated on the farm of S. A. Sellers, Contra Costa County, and introduced by James Shinn. Very large, rich golden color; tree healthy; one of the very best of clings; ripens with Late Crawford. Recommended by Southern California Nurserymen's Association, as a market peach. (See table.)

GOLDEN CLING.—(California.) Originated with A. T. Hatch, Suisun Valley, and commended by him as a canning peach. Approved by G. M. Gray, Rancho Chico.

RUNYON'S ORANGE CLING.—(California.) "Originated with Mr. Sol. Runyon, on the Sacramento River. Superior to the common Orange Cling. Runyon's Orange Cling has globose glands, and is not subject to mildew like the common sort. Fruit very large, yellow, with a dark crimson cheek; rich, sugary, and vinous flavor. Highly esteemed and extensively planted in the Sacramento region and elsewhere."—John Rock.

NICHOLS' ORANGE CLING.—(California.) Originated by Joseph Nichols, of Niles, introduced by James Shinn. Large, yellow, with purple cheek; flesh yellow and good. Tree healthy and a heavy bearer.

PECK'S ORANGE CLING.—(California.) "Originated at Healdsburg, Sonoma County. Improved seedling of Orange Cling, of Downing. Large, handsome, yellow-fleshed, free from curl, hardy, vigorous, productive, superior for market or drying; planted more extensively in Santa Rosa Valley than in any other."—Luther Burbank.

STILSON.—(California.) "Originated at Marysville.(?) Perfect in shape; very large; red cheek with crimson stripes; yellow-fleshed, more highly colored than Susquehanna; table and market quality excellent; ripens after Crawford's Late; freestone."—P. W. Butler.

SUSQUEHANNA.—(Pennsylvania.) Large, nearly globular; suture half round; skin rich yellow, nearly covered with red; flesh yellow, sweet, juicy, with rich, vinous flavor; freestone; tree healthy. Very widely distributed and popular. (See table.)

MCCOWAN'S CLING.—(California.) Originated with Dr. McCowan, of Ukiah. Yellow cling; round, smooth outline; no suture; no red at pit, which is small; flesh firm, fine-grained, and sweet; not much subject to curl; fruit apt to run small unless carefully thinned; reported an irregular bearer in Alameda County; liked by canners; approved in Placer County.

GROVER CLEVELAND.—(California.) Originated as chance seedling, with J. W. Gates, Vacaville. A yellow cling with dark red cheek; flesh very firm, golden yellow, with very slight red at pit; size large and pit small; flavor excellent; tree very hardy and a regular and prolific bearer; fine for shipping and canning; rather apt to be small.

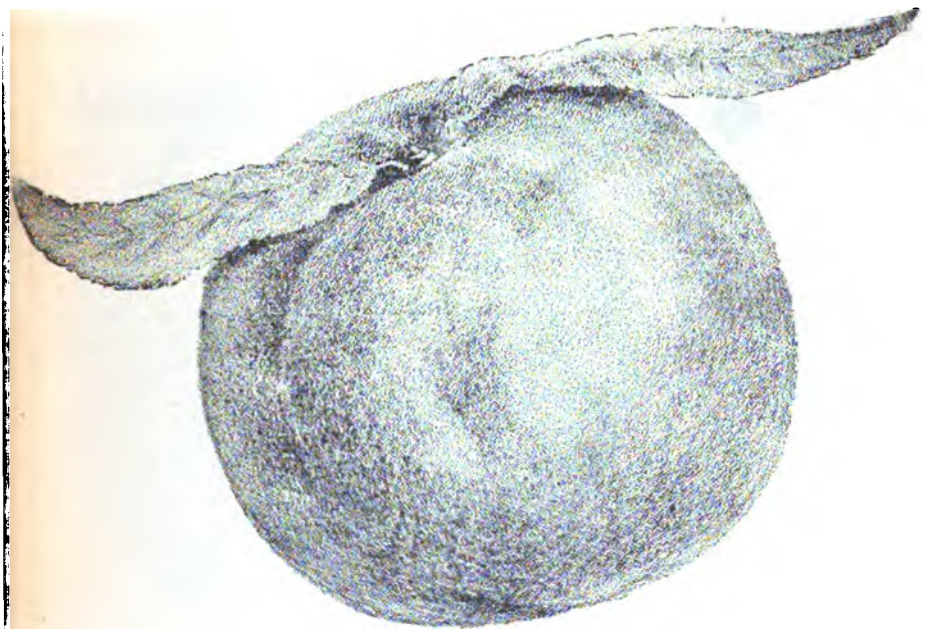
LOVELL.—(California.) Originated as chance seedling with G. W. Thissell, and named by him in 1882; propagated by Leonard Coates, of Napa. Yellow freestone; size uniformly large, almost perfectly round; flesh fine, texture firm, solid, clear yellow to the pit; tree a good grower and bearer; superior for canning and shipping and dries well. Said to curl in some places. Approved in Solano, Sutter, and Placer Counties.

MOTHER PORTER.—(California.) Seedling found by W. W. Smith, in door-yard of Mrs. Porter, near Napa, and propagated by him. Yellow cling, almost as round as an orange; no red at pit, which is very small; very sweet; an excellent canning peach. Favored by several Vaca Valley growers. Apt to be undersized.

ROSEVILLE CLING.—(California.) Originated in Placer County. Large, white, with blush next the sun; good for canning and shipping; liable to curl in some localities. (See table.)

MCINTYRE'S LATE FREE.—(California.) "Large, yellow, fine flavor."—Dr. Eisen. Approved in Fresno, Merced, Sacramento, and Placer Counties.

ROSENBURG CLING.—(California.) "Originated on Kings River, in Fresno County. Large yellow cling; superior to Lemon Cling; full bearer and thrifty grower."—I. H. Thomas, Visalia.



GENERAL BIDWELL—A CALIFORNIA SEEDLING.

MCKEVITT'S CLING.—(California.) Originated as chance seedling in apricot orchard planted by M. R. Miller, on place now owned by A. McKevitt, Vaca Valley; named in 1882 by nurserymen who propagated it. A white clingstone; flesh very firm, fine-grained, sugary, and rich, high flavor, white to the pit; skin strong and fruit excellent for shipping or canning; tree remarkably strong in growth and free from disease. Widely distributed. (See table.)

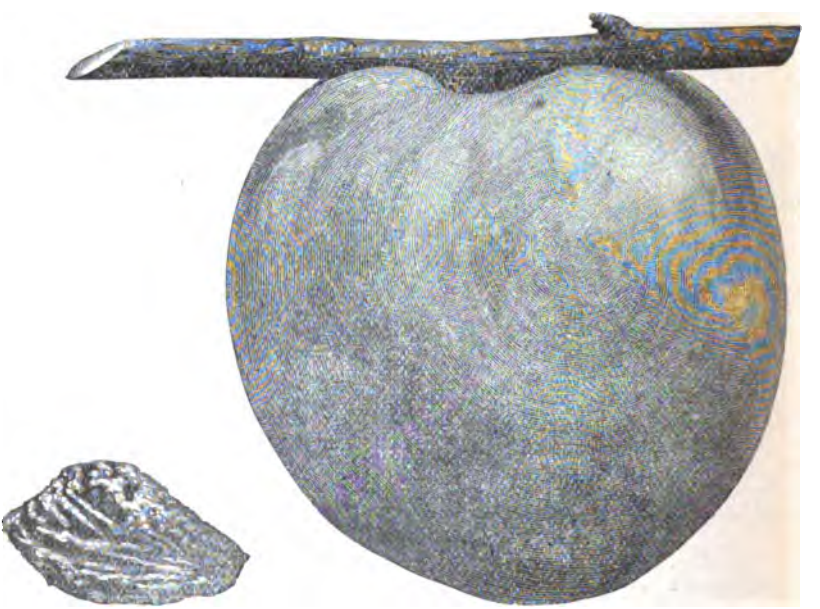
GENERAL BIDWELL.—(California.) Originated from a shoot from a peach root upon which an apricot had grown and died, on Rancho Chico. Named by State Horticultural Society, September 4, 1886, and commended for cultivation. Ripens one week later than Late Crawford and ahead of Salway and Piquet's Late. About the shape of the Orange Cling, but larger; very yellow with reddish cheek; flesh very solid, juicy, and rich; freestone and a small pit.

WARD'S LATE FREE.—Rather large, roundish; white with crimson cheek, flesh white, juicy, and rich. Approved in Tulare and San Diego Counties.

CALIFORNIA; syn. *Edward's Cling.*—(California.) "Originated in Sacramento. Very large, round, regular; orange, nearly covered with dark, rich red; flesh deep yellow; flavor delicate, rich, vinous."—C. W. Reed. (See table.)

BRANDYWINE.—"A seedling of Crawford's Late, and valuable for its large size, fine appearance, good quality, lateness and market value; fruit larger than its parent, and ripens ten days later. Tree a strong grower and productive."—John Bidwell. Approved in Placer and Solano Counties.

JONES' SEEDLING.—(California.) Originated in Sacramento. Very large; yellow with dark red cheek; good flavor; rather soft for long shipment, but good for canning. Reported favorably from Alameda, Sonoma, Amador, and Placer Counties.



PHILLIPS' CLING—A CALIFORNIA SEEDLING.

PICQUET'S LATE.—(Georgia.) Large to very large; round, sometimes a little flattened; yellow, with red cheek; flesh yellow, melting, sweet, rich and fragrant; freestone; not subject to curl leaf. (See table.)

SMOCK FREESTONE.—(New Jersey.) Large; yellow, mottled with red; moderately rich and juicy. (See table.)

BOQUIER.—(California.) "Freestone; very large; yellow, with bright red cheek; excellent flavor; good shipper."—W. R. Strong & Co.

LA GRANGE.—(New Jersey.) Large, oblong; greenish white, some red on sunny side; commended in Tulare and Butte Counties, where it is known as Silver Medal; not desirable in coast regions; freestone.

PRESIDENT.—(New York.) Large, roundish oval; suture shallow; yellowish green with dull red cheek; flesh white, very red at pit, which is free; very juicy, melting, and high flavored. Approved in San Luis Obispo, Stanislaus, and San Bernardino Counties.

SALWAY.—(English.) Large, roundish oblate; suture broad, deep, extending beyond the apex; skin downy, creamy yellow, rich, clear, crimson cheek; flesh deep yellow, red at the pit; juicy, rich, sweet, vinous; freestone; a standard late peach in California; tree very healthy. (See table.)

PHILLIPS' CLING.—(California.) Originated with Joseph Phillips, of Sutter County; propagated by J. T. Bogue, of Marysville. Fine large yellow cling, no color at pit, which is very small; exceedingly rich and high colored; described by Mr Skinner, superintendent Marysville Cannery, as the best peach he ever used.

CRIMSON BEAUTY.—(American.) "Large; creamy yellow, surface half covered with crimson; flesh white to the pit, to which it clings; showy and a good shipper." —I. H. Thomas, Tulare County.

HYSLOP.—(American.) Large, roundish, inclined to oval; white with crimson cheek; juicy, rich flavor; clingstone. Approved in Amador County.

PERSIAN'S CLING.—(California.) "Originated in Visalia, probably from seed of Heath Cling, and a few days earlier than its parent. Large; clear white skin and flesh, the latter very sweet; commended for canning."—I. H. Thomas, Tulare County.

HEATH.—(Maryland.) Described by Downing as the most delicious of all clingstones. Very large; skin downy, creamy white, with faint blush of red; flesh greenish white, very tender and juicy, with most luscious flavor; best adapted to interior regions, or places free from curl. (See table.)

GENERAL GRANT.—(California.) Originated with W. W. Smith, of Vacaville. Very large, fine-looking, cream color, with red cheek, but lacks quality; clingstone; tree healthy; approved in Napa County.

STEADLY.—(Missouri.) "Large to very large; white skin; flesh white at the pit, firm, rich, and good flavor; freestone. Produces very heavy yield of dried fruit." —I. H. Thomas, Tulare County.

WILKIN'S CLING; syn. *Ringold Mammoth Cling.*—"Seedling of Heath and ripening with it. A white cling of largest size; flesh white to the pit; sugary, rich, delicious; tree hardier than Heath and less liable to curl."—John Rock. (See table.)

GEORGE'S LATE CLING.—(California.) "Originated in Sacramento. Large; white flesh, colored around the pit; beautiful yellow color, striped and splashed with bright red; a very heavy and uniform bearer; a good shipper, and at its season of ripening there is no peach grown in Placer County that yields the grower so much profit."—P. W. Butler. Subject to mildew in some localities. (See table.)

LYON'S CLING.—(California.) Originated with W. M. Williams, of Fresno. Very large; white, flesh clear white to the pit; commended by the Fruit Growers' Convention of 1884, as entitled to prominent place because of its lateness and good flavor.

HARDY WHITE TUSCANY. (*Dura cini Tuscany.*)—A very large white cling, probably as large a peach as exists; propagated by G. Tosetti, of San Leandro; clear white, with inclination to light pink on exposed side; flesh very firm, white to the pit; subject to curl-leaf.

HARDY YELLOW TUSCANY.—Similar to above in size and quality, but of deep yellow color; does not curl.

ALBRIGHT'S CLING.—(California.) "Originated with Mr. Albright near Placerville. Very large; yellow, with bright cheek, rarely equaled in quality and flavor. Described as larger, more highly colored, of better flavor, better shape, and the tree a more prolific bearer than the Orange Cling."—P. W. Butler. Endures long shipment well even after being well colored. Approved in Placer, El Dorado, Butte, and Sutter Counties.

MCDEVIT CLING.—"Originated with Neal McDevit, of Placer County. Uniformly large; rich, golden yellow, becoming red when ripe; flesh very firm and solid, superior in flavor; excellent shipper; tree good and regular bearer."—Robert Williamson. Awarded first prize at the State fair in 1887 and 1888, as grown by J. A. Robinson, of Newcastle.

GAREY'S HOLD-ON.—(Southern.) "Seedling of Smock; large; pale lemon yellow; freestone; ripens ten days after Smock; valuable when late kinds are desirable."—John Bidwell. Useless in late regions, as on the coast and in Southern California.

LATE YELLOW ALBERGE.—(French.) Medium size, roundish oval; skin green, becoming yellow; flesh yellow to the stone, to which it clings; firm, somewhat juicy.

YELLOW COBBLER.—"New, large, yellow freestone; resembling Salway, but two weeks later."—John Rock. Grown in Vaca Valley.

STALEY.—(California.) Very large; eleven and one-half inches in circumference; somewhat elongated and flattened laterally; rich, creamy white with very faint touches of light red; suture shallow, but almost continuous around the peach; stone small and perfectly free, cavity considerably longer than stone; flesh white to the pit, very juicy, fine, tender; flavor delicious. Originated as sucker from peach root from which prune had been broken off in Selma, Fresno County. Ripens twenty days after Salway or four weeks after Susquehanna. A high-class white freestone. Introduced by F. M. Nevins, Selma.

LEVY'S LATE; syn. *Henrietta.*—(District of Columbia.) Above average size, yellow flesh, red cheek; late; clingstone. Approved in Placer County.

BILYEU'S LATE OCTOBER.—"Large; greenish white with red cheek; flesh whitish, freestone; tree a rapid grower and attains great size; prolific bearer; fruit ships well, and where it will mature no peach can take its place; does particularly well in the foot-hills."—P. W. Butler. Discarded in coast regions and in Southern California. (See table.)

BUCK'S SEEDLING.—(California.) Originated with L. W. Buck, Vaca Valley. Large; finely colored; good quality; shipped East successfully.

BUCK'S PROLIFIC OR DECKER.—(California.) Grown for Eastern shipment, in Vaca Valley, and reported favorably from Sutter County.

MRS. BRETT.—(New York.) Medium, roundish; whitish shaded with dark red; flesh white, red at pit, which is free; juicy, melting, sweet, and rich. Approved in Solano and Tulare Counties.

DECEMBER.—White cling occasionally grown because of its extreme lateness, but hardly worth propagation.

OTHER CALIFORNIA SEEDLINGS.

In the foregoing enumeration only those seedlings which have been commercially propagated are included. The writer has record of many others, some of them likely to rise to important place, which are reserved until after further trial.

COMMENDED LISTS OF PEACHES.

By studying the foregoing data one can arrive at an approximate knowledge of varieties which have proved their adaptation to certain localities. It may be well, however, to present a few lists locally commended:—

FOR ALAMEDA AND SANTA CLARA COUNTIES.—"A succession of fine yellow freestone peaches, curling little or not at all, and ripening in the following order: Early Crawford, Foster, Richmond, Mary's Choice, Susquehanna, Honest Abe, Jones' Seedling, Picquet's Late, Smock's Late (Beers' Strain), and Salway."—James Shinn.

FOR PLACER COUNTY.—"A succession of varieties covering the whole peach season, from June to October: Freestones, Hale's Early, Foster, Day's Yellow Free, Susquehanna, Stilson, Salway, Bilyeu's Late October, Clingstones, Baxter's Cling, Albright's Cling, George's Late Cling."—P. W. Butler.

FOR UPPER SAN JOAQUIN VALLEY.—"Early Waterloo, Governor Garland (Yellow Freestones), Foster, Crawford's Early, Susquehanna, Muir, Crawford's Late, Jones' Seedling, Seller's Free, Mary's Choice, Salway (White Freestones), Steadly, Watson's Free, Silver Medal, Late Admirable (Yellow Clingstones), Rosenberg, Lemon Cling, Orange Cling, Seller's Golden Cling (White Clingstones), Persian, Ringold Mammoth, Lord Palmerston, Heath, Chinese Cling, Thomas Cling, Crimson Beauty."—I. H. Thomas.

FOR SOUTHERN CALIFORNIA.—Approved by Southern California Nurserymen's Association, 1886: For market and canning: Crawford's Early, Bergen's Yellow, Foster, Late Crawford, Orange Cling, Seller's Golden Cling, Salway, Smock. For family use the following, ripening about in the order named: Alexander, Early Strawberry, Hale's Early, George the Fourth, Stump the World, Old Mixon, Free, and Morris White.

FOR THE VACAVILLE DISTRICT.—Reported by various growers: Governor Garland, Briggs' May, Alexander, Waterloo, Hale's Early, Yellow St. John, Strawberry, Foster, Crawford's Early, Mary's Choice, Reeves' Favorite, Lord Palmerston, Crawford's Late, Brandywine, Susquehanna, Honest Abe, Grover Cleveland Gates' Cling, Muir, McKevitt's Cling, Roseville Cling, Lemon Cling, Orange Cling, Runyon's Orange Cling, Seller's Golden Cling, Mother Porter, Lovell, Picquet's Late La Grange, Salway, Heath, George's Late Cling, Yellow Cobbler, Bilyeu's Late, Henrietta, Miller's Late Free, Thanksgiving.

This list includes varieties covering the season from June 1 to December 1. The last two named are very late local seedlings, of which only a few are grown.

TABULAR STATEMENT OF ADAPTATIONS.

The following pages contain tabular statements of varieties found most successful in growth, and commercially profitable in the counties named. As has been already stated in connection with other fruits, these marks are affirmative and do not necessarily infer that these only succeed in the region covered by the reports, nor that all counties not reported do not grow peaches. The table does present, however, the varieties which now constitute the weight of the peaches produced in the State. They are arranged approximately in the order of ripening.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS, NAMING VARIETIES OF THE PEACH MOST SATISFACTORY IN THE COUNTIES SPECIFIED.

COUNTIES OF CALIFORNIA.	Briggs' Red May	Alexander	Hale's Early	Parson's Early	Early Tillotson	Strawberry	Large E'ly York	Foster	Crawford's E'ly.	George the 4th.	Bergen's Yellow	Oldmixon Free.	Chinese Cling	Honest Abe	Morris White	Wager	Whitehand
Del Norte	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Humboldt	*	.	.	.	*	.	*	*	*	.	.	*	.	.	.	.	.
Mendocino	.	*	*	.	.	.	*	*	*	.	.	.	.	*	.	.	.
Lake	*	*	*	.	*	.	.	*	*	.	.	.	.	.	*	.	.
Napa	.	*	*	.	.	.	.	*	*	.	.	.	.	*	.	*	.
Sonoma	.	*	*	.	*	.	*	*	*	.	.	.	*	.	*	.	.
Marin	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Contra Costa	*	*	*	.	.	*	.	.	.	.	.	.	.	*	.	.	.
Alameda	*	*	*	.	.	.	*	*	*	.	.	.	.	.	*	.	.
Santa Clara	*	*	*	.	.	.	*	*	*	.	.	.	.	.	.	*	.
San Mateo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.
Santa Cruz	*	*	*	*	.	*	*	*	*	.	.	.	.	.	.	.	.
San Benito	*	*	*	.	.	.	.	.	*	.	.	*	.	.	.	*	.
Monterey	.	*	*	.	.	.	*	*	*	.	.	.	.	.	.	.	.
San Luis Obispo	.	*	*	.	.	.	*	*	*	.	.	.	.	.	*	.	.
Santa Barbara	.	*	*	.	.	.	*	*	*	.	.	.	.	.	*	.	.
Ventura	*	*	*	.	*	*	.	*	*	.	.	.	.	.	*	.	.
Los Angeles	*	*	*	.	*	*	*	*	*	.	.	.	.	.	*	.	*
San Diego	*	*	*	.	*	*	*	*	*	.	.	*	.	.	*	.	.
San Bernardino	*	*	*	.	*	*	*	*	*	.	.	*	.	.	.	.	*
Kern	.	*	*	.	.	.	.	*	*	.	.	*	.	*	.	.	.
Tulare	.	*	*	*	.	.	.	*	*	.	.	*	*	.	*	.	*
Fresno	*	*	*	.	.	.	.	*	*	*	.	.	*	.	.	.	*
Merced	*	*	.	.	.	.	*	*	*	.	.	.	*	*	.	.	.
Stanislaus	*	*	*	.	.	.	.	*	*	.	.	.	.	.	*	.	.
San Joaquin	*	*	*	.	.	*	.	*	*	.	.	.	*	.	.	.	*
Sacramento	*	*	*	*	.	.	.	*	*	.	.	*	*	*	.	*	*
Solano	*	*	*	.	.	*	.	*	*	.	.	*	*	.	*	.	.
Yolo	*	*	*	*	.	.	.	*	*	*	.	.	*	.	.	.	.
Sutter	*	*	.	.	.	.	.	*	*	.	.	*	*	.	.	*	*
Yuba	*	*	*	.	.	.	.	*	*	.	.	.	*	.	.	.	*
Butte	*	*	*	.	.	.	.	*	*	.	.	*	*	.	*	*	*
Colusa	*	*	*	.	.	.	.	*	*	.	.	.	.	*	.	.	.
Tehama	*	*	.	*	.	.	.	*	*	.	.	.	.	.	*	.	.
Shasta	.	.	.	.	.	*	.	*	*	.	.	.	.	.	.	.	.
Trinity	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siskiyou	.	.	.	.	.	.	*	.	*	.	.	.	.	.	*	.	.
Modoc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lassen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plumas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sierra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nevada	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Placer	*	*	*	*	.	.	.	*	*	.	.	.	*	.	.	.	*
El Dorado	*	*	*	.	*	*	.	*	*	.	.	.	.	.	.	.	.
Amador	*	.	*	.	*	.	*	*	*	.	.	.	.	.	*	.	.
Calaveras	*	*	*	.	.	.	.	*	*	*	.	.	*	.	.	.	.
Tuolumne	*	*	*	.	.	.	.	.	*	.	.	.	.	.	*	.	.
Mariposa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alpine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mono	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*	.	.
Inyo	*	.	*	.	.	.	.	*	*	.	.	.	.	.	.	.	.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS, NAMING VARIETIES OF THE PEACH MOST SATISFACTORY IN THE COUNTIES SPECIFIED.

COUNTIES OF CALIFORNIA.	Stump the World	Crawford's Late	Lemon Clingst'e	Orange Clingst'e	Seller's G. Cling	Muir	Susquehanna	McKevitt's Clg.	California	Roseville Cling.	Picquet's Late	Smock Freest'e.	Salway	Heath	Wilkin's Cling.	George's L. Cling	Bilyeu's L. Oct.
Del Norte	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Humboldt	.	*	*	*	.	*	.	.	.	.	.	.	.	*	.	.	.
Mendocino	.	.	*	.	.	.	*	.	.	.	.	.	*	.	.	.	.
Lake	.	*	.	*	.	.	.	.	.	.	.	.	.	*	.	.	.
Napa	.	*	*	*	*	*	*	.	.	.	.	.	.	.	.	.	.
Sonoma	.	*	*	*	*	*	.	.	.	.	.	.	*	.	.	*	.
Marin	.	.	.	.	*	.	*	.	.	.	.	*	*	.	.	.	.
Contra Costa	.	*	.	*	*	.	*	.	.	.	.	*	*	.	.	.	.
Alameda	.	*	*	.	*	*	*	.	.	.	.	*	*	.	.	.	.
Santa Clara	.	*	*	*	*	*	*	.	.	.	.	*	*	.	*	.	.
San Mateo	*	*	.	.	.	.	.	.	.	.	.	*	*	.	.	.	.
Santa Cruz	.	*	*	*	.	*	.	.	.	.	.	*	*	.	.	.	.
San Benito	.	*	*	.	.	.	.	.	.	.	.	*	*	*	.	.	.
Monterey	.	*	.	.	.	.	.	.	*	.	.	*	*	.	.	.	.
San Luis Obispo	*	.	.	*	*	.	.	.	.	.	.	*	*	.	.	.	.
Santa Barbara	*	*	*	.	*	.	.	.	.	.	.	*	*	.	.	*	.
Ventura	*	*	*	.	*	.	.	.	.	.	.	*	*	.	.	.	.
Los Angeles	*	*	*	.	*	.	*	.	.	.	.	*	*	*	.	.	*
San Diego	*	*	*	.	*	*	*	.	.	.	.	*	*	*	.	.	.
San Bernardino	*	*	*	*	*	.	*	.	.	.	*	*	*	.	*	.	.
Kern	.	*	*	.	*	.	.	.	.	.	.	.	.	.	.	*	.
Tulare	.	*	*	.	*	*	*	.	.	*	.	*	*	.	.	.	*
Fresno	.	.	*	*	*	.	*	.	.	.	.	*	*	.	*	.	.
Merced	.	*	*	.	.	*	*	.	.	.	.	*	*	.	.	*	.
Stanislaus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
San Joaquin	.	*	*	*	*	*	*	.	.	.	.	*	*	*	.	*	*
Sacramento	.	*	*	*	*	.	*	.	*	.	.	*	*	*	.	*	*
Solano	.	*	*	*	*	*	*	*	*	*	*	.	*	*	.	*	*
Yolo	.	*	.	.	*	*	*	*	*	*	.	.	*	*	.	*	*
Sutter	.	*	.	.	*	.	*	*	*	*	.	.	*	*	*	*	*
Yuba	.	*	*	*	.	.	*	*	*	*	*	.	*	*	*	*	*
Butte	.	*	*	*	*	*	*	*	*	*	*	.	*	*	*	*	*
Colusa	.	*	.	.	*	.	*	*	*	*	.	.	.	.	.	.	.
Tehama	.	*	.	.	*	.	*	.	.	.	.	.	.	.	.	.	.
Shasta	.	*	.	.	*	.	.	.	.	.	.	*	.	.	.	.	.
Trinity	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siskiyou	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Modoc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Sierra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nevada	.	.	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.
Placer	.	*	*	*	*	.	*	*	*	*	*	*	*	.	.	*	*
El Dorado	.	*	.	*	*	.	*	.	.	.	.	.	*	*	.	*	*
Amador	.	*	*	*	.	*	.	.	.	.	.	.	*	*	.	.	.
Calaveras	.	*	*	*	.	.	.	.	.	.	.	.	.	*	.	.	.
Tuolumne	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mariposa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alpine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mono	*	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inyo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

CHAPTER XX.

THE NECTARINE.

THE nectarine reaches perfection under California conditions, as does its close relative, the peach. The fruit is, in fact, as Downing says, only a variety of the peach with a smooth skin; only a distinct, accidental variety of the peach; and this is rendered quite certain, since there are several well-known examples on record of both peaches and nectarines having been produced on the same branch. Nectarine pits usually produce nectarines again, but they occasionally produce peaches. Peach seeds occasionally produce nectarines; the Boston variety originated from a peach stone.* All these facts which are recorded of the relation between the peach and nectarine have been verified by California observation.

The practice of growing nectarines is also exactly like that employed with the peach. It is propagated and pruned in the same ways, and it is affected by the same diseases. It is the same in its natural adaptations and requirements, so that what has been given concerning the growth of the peach in this State has an apt application in the case of the nectarine.

The success of the nectarine worked on almond stock, as has been demonstrated by the experience of many, has led to the grafting over of a good many unprofitable almond trees to nectarine, though this has not been done to the extent to which the French prune and some other plums have been worked on old almond stocks.

COMPARATIVE PRODUCTION OF NECTARINE AND PEACH.—It may be wondered, considering the similarity of the peach and the nectarine, why the former is our leading fruit and the latter is the least grown, but one, of all the temperate zone fruits, only the lowly quince being less in importance. The explanation is that the fruit buyer, both in California and at the East, prefers the peach, whether it be fresh, or canned, or dried, and some of those who have tried even a few acres of nectarines have found many occasions to wish the ground had been given to peaches. How much of this preference is due to lack of knowledge of the nectarine, and how much to its somewhat different flavor, it would be difficult to accurately determine.

* "Downing's Fruit and Fruit Trees," p. 565.

It is altogether probable that the nectarine will advance in popular favor. This has been prophesied for some years, it is true, the expectation being based upon the wonderful excellence of the nectarine as grown in our interior valleys, and the passing beauty of the amber translucency of the dried nectarine, both when sun-dried in the interior, and when produced by machine evaporators. The excellence of the canned nectarine has also figured in the anticipation. It must, however, be acknowledged that anticipation has not yet been largely realized, for it is estimated that the amount of dried nectarines is but five per cent, and of canned nectarines considerably less than two per cent, of the respective forms of peaches. Nor does the demand call for change in this proportion, for there is a slight advantage in the market value of the peach even in its great preponderance of supply. Still, it is true that the nectarine is slowly growing in favor, and there are many who are very confident that it will in the future rank much higher in the California fruit product. It would please growers and fruit driers and canners to popularize the nectarine, for its smooth skin makes it as easy to handle as an apricot, and the beauty of the product, which certainly exceeds that of the peach, and is rather more easily attained, is very gratifying to the producer.

VARIETIES OF THE NECTARINE.

Varieties of the nectarine, as of the peach, show different local adaptations, and are valued by growers accordingly. The varieties grown are, however, comparatively few. The following have been found most satisfactory in California; the descriptions are somewhat condensed from Downing's treatise, modified to suit local growth, and arranged approximately in the order of the ripening of the varieties:—

LORD NAPIER.—(English.) Large, pale cream color with dark red cheek; flesh white, melting, tender, and juicy, separating freely from stone; leaf glands reniform and flowers large. Especially commended by I. H. Thomas, of Tulare County, as a heavy and regular bearer.

PITMASTON ORANGE.—(English.) Tree vigorous, leaves with globose glands, flowers large; fruit large, roundish oval, base toward the stem broad, and top narrow, ending in acute, swollen point; skin rich orange yellow, with dark reddish brown cheek, streaked at the union of the two colors; flesh deep yellow, red at the stone, melting, juicy, rich, sweet, and good flavor; pit small and free. Reported as making heavy yield of dried fruit.

VIOLETTE HATIVE.—(French.) Leaves with reniform glands; flowers rather small; fruit large, roundish; skin pale, yellowish green in the shade, but when exposed nearly covered with dark purplish red, mottled with pale brown dots; flesh whitish, but much rayed with red at the stone; flesh melting, juicy, rich and high flavored. This variety has too much color to commend it for ordinary California uses, but is commended by some growers.

DOWNTON.—(English.) Leaves with reniform glands; flowers small; fruit large, roundish oval; skin pale green, with deep, violet red cheek; flesh pale green, slightly red at the stone, which is free, melting, rich, and very good. Favorably reported from Santa Barbara, San Joaquin and Butte Counties.

ELRUGE.—(English.) Leaves with reniform glands, and flowers small; fruit medium size, roundish oval, suture slight, except at the top, where it is distinctly marked; skin pale green, deep violet in the sun, or blood red with minute brownish specks; flesh pale green to the stone, which is free, of oval shape, rough and pale color. Favorably reported from Napa and Tulare Counties.

EARLY NEWINGTON.—(English.) Leaves serrated without glands, flowers large; fruit large, roundish ovate, a little enlarged on one side, and terminating with an acute, swollen point; skin pale green, but nearly covered with bright red and coated with thin bloom; flesh greenish white, but deep red at stone, which adheres closely, juicy, sugary, rich, and excellent. Favorably reported from Los Angeles, Fresno, and Butte Counties.

HARDWICKE.—(English.) Leaves with globose glands; fruit very large, roundish, inclining to oval; skin pale green, with deep violet red cheek; flesh pale green, slightly marked with red at the stone, melting, rich, and high flavored; freestone. This variety is a favorite in Southern California, being described by the Southern California Nurserymen's Association as being the only satisfactory bearer. In some locations, however, some other varieties do well, but cannot be generally commended, as is the Hardwicke.

BOSTON.—Raised from a peach stone by T. Lewis, of Boston; tree hardy and productive; leaves with globose glands; flowers small; fruit large and handsome, roundish oval, bright yellow, with deep red cheek; flesh yellow to the stone (which is small and pointed), sweet, though not rich, with pleasant and peculiar flavor; freestone; a general favorite in California.

NEW WHITE; syn. *Large White.*—Leaves with reniform glands; flowers large; fruit rather large, nearly round; skin white with occasionally slight tinge of red; flesh white, tender, very juicy, with rich, vinous flavor; stone small and free; commended wherever nectarines are grown in California.

RED ROMAN.—Leaves with reniform glands; flowers large; fruit large, roundish, little flattened at the top; skin greenish yellow, with brownish, muddy, red cheek, somewhat rough and marked with brown specks; flesh firm, greenish yellow, deep red at the stone, juicy, and rich. Commended in Lake, Ventura, Los Angeles, San Bernardino, Kern, Tulare, Sacramento, Colusa, Tehama, Placer, and Amador Counties.

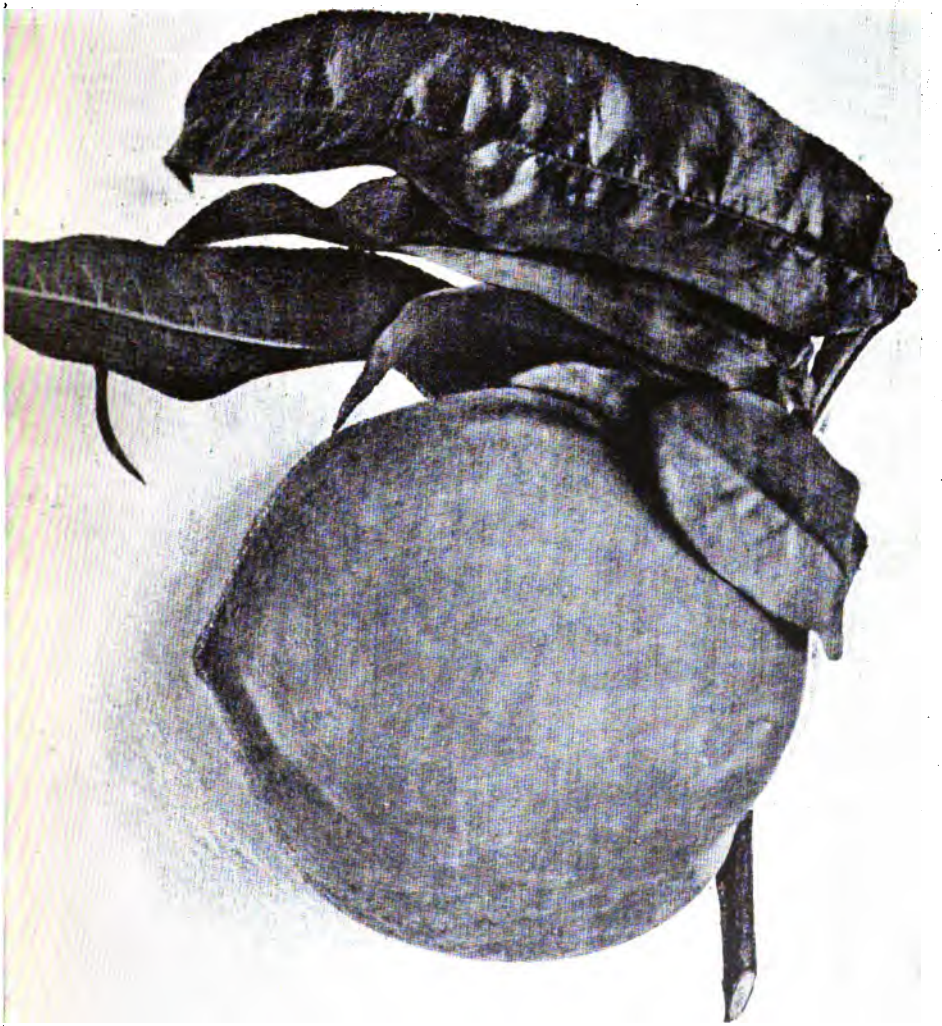
STANWICK.—Originated in England from seed brought from Syria. Large, roundish oval, slightly heart-shaped at base; skin pale, greenish white, shaded into deep, rich violet in the sun; flesh white, tender, juicy, rich, sugary, and delicious. Commended in El Dorado and San Joaquin Counties.

CALIFORNIA SEEDLING NECTARINES.

DODD'S.—Originated from the seed in Tulare County, and described by I. H. Thomas: "A large freestone; white flesh, red cheek, and fully three weeks later than all other varieties, ripening here from September 1 to September 15."

SMITH'S SEEDLING.—Originated with W. W. Smith, of Vaca Valley, and planted to some extent in the neighborhood as a fine drying nectarine.

YO SEMITE.—A seedling nectarine from a peach pit reported from the Yo Semite Valley, by J. A. Hennessey, and described as extra large, dark red with golden yellow flesh, pit large; ripens August 1; three other nameless seedling nectarines are reported by the same party.



As the future for the nectarine seems to rest upon drying and canning of the fruit, the light-skinned, white or yellow-fleshed varieties without color at the stone, are most desirable. For drying there has been thus far a decided preference for free-stone varieties, though possibly the present popularity of cling peaches for drying may extend to the clingstone nectarines. Much color, however, either in skin or flesh, will prevent the production of the beautiful translucent, amber hue of the dried nectarine, which bids fair to be attractive to consumers. Color in the flesh is, of course, undesirable in canning, because of discoloration of the syrup. These facts have had much to do in fixing the popularity of the varieties named in the foregoing list.

At present the largest orchards of nectarines are in Solano, Fresno, Tulare, and San Bernardino Counties, which are also fine peach counties and are perfectly adapted both to the growing of the fruit and to the open-air, sun-drying of the fruit.

CHAPTER XXI.

THE PEAR.

THE oldest deciduous fruit trees in California are pear trees, as has already been stated in the account of fruits at the old missions. The pear withstands neglect and thrives in soils and situations which other fruit trees would rebel against. It defies drought and excessive moisture, and patiently proceeds with its fruitage, even when the soil is trampled almost to rocky hardness by cattle, carrying its fruit and foliage aloft above their reach. And yet the pear repays care and good treatment, and receives them from California growers, for the pear is one of our most profitable fruits. It is in demand for canning and for distant shipment, and its long season and the slow ripening after picking allow deliberation in marketing, and admit of enjoying low rates for shipment by slow trains. The pear has not the beauty of the peach, nor is its handling characterized by so much dash and spirit, but the production of favorite market varieties at a time when the market welcomes them, is about as well repaid as any effort of the California fruit grower.

The most obvious marks of the California pear are size and beauty. The most conspicuous example is the Bartlett, which is *the* pear of California, judged by its popularity, both fresh and canned. When well grown, its size is grand, and its delicate color, aroma, and richness unsurpassed. What extreme in point of size has been reached is not known to the writer, but he saw at the San Jose Horticultural Fair, of 1886, thirteen Bartlett pears grown by A. Block, of Santa Clara, which weighed fourteen pounds, the heaviest of the group weighing twenty-two and one-half ounces. Other pears have made standard sizes in California far in advance of their records elsewhere. There was in 1870 a Pound pear sent from Sacramento to the late Marshall P. Wilder, president of the American Pomological Society, which weighed four pounds nine ounces, and was reported by Colonel Wilder to be larger than anything previously recorded in pear annals.* Notes kept by the writer include five Vicar of

*Tillon's *Journal of Horticulture*, March, 1871, p. 87. An engraving of this fruit, natural size was given in *Pacific Rural Press*, Nov. 8, 1873.

Winkfields weighing four pounds eight ounces; nine Easter Beurre weighing twenty-four and one-half pounds, the heaviest single specimen weighing two and three-fourths pounds; thirty-five Beurre Clairgeau weighing thirty-seven pounds, the heaviest one, nineteen ounces; Seckel pears, nine and three-fourth inches in circumference—Downing's figure makes the Seckel five and seven-eighths inches around.

LOCALITIES FOR THE PEAR.

The pear has a wider range than the apple in local adaptations. It does as well as the apple in the coast regions, if suitable varieties are grown; it thrives far better than the apple in the interior valleys; it rivals the apple in the ascent of the slope of the Sierra Nevada, and gains from the altitude, color and late keeping, as does the apple. By rejecting a few naturally tender varieties, or those susceptible to the attacks of the fungus (*fusicladium dendriticum*), in regions where its attacks are severe, one can grow pears almost everywhere in California.

The choice of location is governed more by commercial considerations than by natural phenomena. The same facts which make the Bartlett the favorite variety with planters, also should regulate the choice of locality for growing it. These facts have been expressed by C. W. Reed, of Sacramento, one of the leading pear growers and shippers of the State, as follows:—

> In the Sacramento Valley proper there is but one variety of pear that will justify extensive cultivation, viz., the Bartlett. While nearly all varieties may be grown successfully, and many varieties may be desirable for home purposes, yet for profitable orchards we have to confine ourselves to this one variety, except in high altitudes, or localities where the fruit only matures very late. The reason for this will be better understood by the inexperienced if explained. The Bartlett pear having qualities that make it a universal favorite for shipping, canning, and for domestic market, no other variety is wanted while it is obtainable. With the difference in the time of its ripening in different localities that are adjacent, our markets are supplied with this variety about four months each season, viz, July, August, September, and October. While this pear is in the markets, any other variety to compete with it must sell at very low prices. It is not only the great demand the Bartlett pear has over other varieties in the markets, but as a healthy grower and regular bearer it has no equal. In the higher altitudes, where pears will keep till the Bartlett has disappeared, other varieties may be quite profitable, although they can never be grown to any similar extent.

Of course experienced pear growers, whose taste would soon cloy with a continuous diet of Bartletts, and who know fully the superior quality of other varieties which ripen soon after it, would dispute the position taken by Mr. Reed, but for present California taste and trade he is undoubtedly correct. As the canners and shippers and local consumers all call for Bartletts, and as they usually sell at the East for nearly twice the price of other varieties, the choice of location to secure a

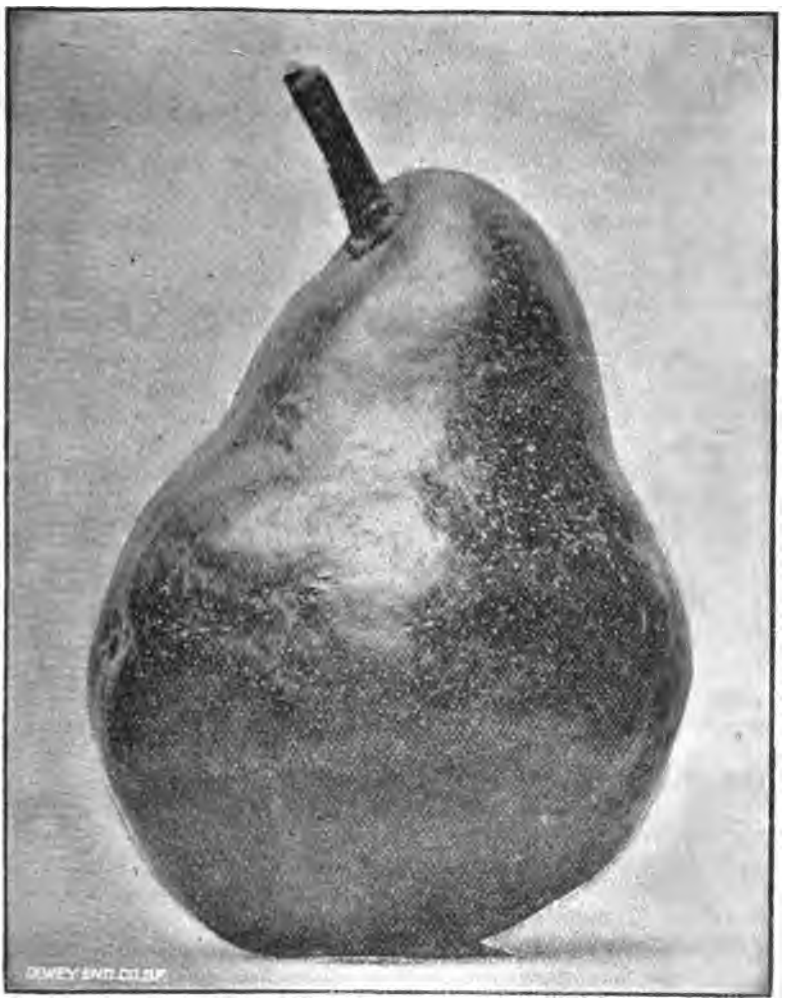
Bartlett, either very early or very late, is the part of wisdom, for either end of the season usually yields better prices than the middle. Some growers are even extending the Bartlett season by growing Clapp's Favorite, which sells well because it is taken for a Bartlett. The earliest Bartletts come from the Sacramento Valley; the next, from the valleys adjacent to the bay of San Francisco; the next, from the foot-hills of the Sierra Nevada; and the last, so far as present experience goes, although some coast and mountain situations are quite late, reach the market from the Vacaville district. It is an interesting fact that this district, which has long been famous for marketing the first early fruits, should also market very late ones. It is true, however, that early fruits hasten to maturity and late fruits are retarded. Late fruits push along until about midsummer, then stop growing for a month or two during the hottest weather, and afterwards proceed on their course and finish up well. W. W. Smith, of Vaca Valley, has picked Bartletts as late as November 19, but that is unusually late. In years with heavy late spring rains the Bartlett ripens earlier in the Vaca Valley than in ordinary seasons, and when the fruit sells well at the East, the Bartletts are gathered green and shipped all through the season, as their first growth usually makes them large enough for this purpose.

Though the Bartlett is in wide favor, as stated, there is some progress being made in introducing other varieties, as will be stated in connection with the discussion of the adaptations of varieties. This substitution of other sorts is in part because the merit of others is being recognized, and in part because in some regions some of them are healthier and more trustworthy bearers than the Bartlett.

There is produced in some situations a "second crop" of Bartletts which is of account, the bloom appearing upon the tips of the shoots of the current season's growth.

SOILS FOR THE PEAR.

The pear will generally do well on shallow soil and over a tight, clay hardpan, where most other fruits would be unsatisfactory or fail utterly. The trees will thrive in clay loams, and even in adobe, if properly cultivated. In laying out fruit farms, which often include a variety of soils, even in comparatively small area, the pears and plums (if on the right stock, as will be seen), should be set on the lower, moister, stiffer soil, and other fruits on the lighter, warmer, and better-drained portions. The pear, however, enjoys the better situation, though it will thrive on the poorer. The tree seems to attain its greatest growth and heaviest bearing on the alluvial soils of the valleys and near the



THE BARTLETT PEAR AS GROWN IN CALIFORNIA.

This is a medium-sized specimen, and was grown by James O'Neil, of Haywards, from a bud brought from original Bartlett stock in Massachusetts.

banks of rivers and streams. All pears will be later in maturing and have better keeping qualities if grown on a clay subsoil. Thus it appears that the pear will flourish whether the water is near or far from the surface. As compared with the apple, it may be said that on wet land the apple tree dies in a few years, or becomes worthless. On dry land it lives longer, but the fruit is small and tasteless, and comparatively worthless. But the pear tree will bear good fruit, under the same conditions, and its market price will average three times more than that of the apple.

It has been learned by experience at the South that the pear will flourish on soil too strongly charged with alkali for the well-being of any other fruit tree. Parish Brothers, of San Bernardino, have a few Bartlett pears on very wet alkaline soil—too alkaline for farming. The trees bear heavily, but have only attained about half the size they would on good soil, and seem more inclined to overbear. The Vicar bears small crops of large fruit. The ground is covered with a heavy salt grass sod, and the trees have been neglected. Out of a dozen pear trees in this situation, in 1872, four are now living. Mr. Parish's conclusion is that he does not recommend alkaline soil for pears, but pears for alkaline soil, and it may be generally useful to know what fruit can be grown in such forbidding soil.

PROPAGATION AND PLANTING.

As stated in the chapter on propagation, the use of dwarfing stock for the pear has been nearly abandoned in this State, though in early years the quince was largely used. The most prominent orchard on quince stock is that of A. Block, of Santa Clara, where may be seen dwarf trees set eight feet apart in squares, which are doing exceedingly well under his liberal system of manuring and irrigation. It is quite possible that, at least for gardens, we shall see in the future more use made of dwarf trees, but for commercial orchards there appears no need of dwarfing. It is better to have fewer trees and larger ones.

The following varieties are commended for cultivation on quince stock as dwarfs, experience proving them vigorous growers, abundant bearers, and otherwise highly remunerative in suitable localities: Beurre Hardy, Doyenne du Comice, Duchess d'Angouleme, Beurre Diel, White Doyenne, Easter Buerre, Winter Nelis, Colonel Wilder, P. Barry, Glout Morceau.*

But, as stated, the pear is usually grown in California on its own roots. It comes into bearing early enough, and is a long-

* Catalogue California Nursery Co.

lived tree. Trees are grown by either budding or grafting, as described in the chapter on that subject. Only good seedling roots should be used, and not suckers from old trees. Seed from the Seckel or the Louise Bonne de Jersey is chosen for growing seedlings by some propagators. In regions subject to smut, some stronger grower free from fungus should probably be preferred.

The Japanese stock, so called, being seedlings of the Sand Pear, of Asia, is now being used to some extent by our tree growers. It makes a vigorous growth and promises to be successful and satisfactory.

DISTANCE IN PLANTING.—If the pears are to have the whole ground, it is usual to plant from twenty to twenty-four feet apart on the square. As the tree is slower to attain size and full bearing than the stone fruits, and as it is a long-lived tree, the pears are sometimes set twenty-four feet with plums in quincunx. Peaches and apricots are also set between pears sometimes, but not often, for the soil commonly chosen for pears does not suit them unless they are on plum roots.

PRUNING.

Usually the pear is grown in the vase form, as described in the general chapter on pruning. With regular, upright growers heading low and cutting to outside buds results in a handsome, gently-spreading top, and effectually curbs the disposition which some varieties, notably the Bartlett, have to run straight up with main branches crowded together. As with other fruit trees, the pear must be studied and pruning must be done with an understanding of the habit of the variety under treatment. Irregular and wayward growers, which, in windy places, also have their rambling disposition promoted by prevailing winds, often give the grower much perplexity. The general rules of cutting to an outside bud to spread the tree, to an inside bud to raise and concentrate it, and to an outside bud one year and an inside bud the next, if a limb is desired to continue in a certain course, are all helpful to the pruner. But with some pears, of which the Winter Nelis is a conspicuous example, it is exceedingly hard to shape the tree by these general rules, and some growers abandon all rules, merely shortening in where too great extension is seen, or to facilitate cultivation, and trust to shaping the tree when it shall have finished its rampant growing period. It will be interesting to cite a few methods of California pear growers:—

"The Winter Nelis pear is an uncouth grower. Let the trees alone until they have borne a good, heavy crop, and the limbs come down and spread out nicely; this will occur in five or six years after setting. This will give you an idea what you want to do with the balance of the top that is not borne down with fruit. My plan is to cut straggling branches, thin out so that the branches will not wind around each other, but don't cut the top, for you will find that the more you cut the more wood you get, and after the tree comes into full bearing is plenty time to head back. It is a general rule for everyone to commence cutting as soon as the branches begin to form. This is all wrong. Nature will attend to her duty until the tree begins to bear too heavily. Leave three branches to start with, and you are all right."—A. Cadwell, Petaluma.

"Our orchard is not in a very windy place, but still it is windy enough to throw our Nelis trees out of form. To get any regularity of shape, we cut off every year all the shoots growing low down on the leeward side, shortening in what are left as occasion may require, to an inside bud. On the windward side we rarely cut any branch out, but shorten in a little to an outside bud, frequently being obliged to cut back a strong shoot to a lateral which is growing outward."—Leonard Coates, Napa.

"It is hard to get a misshapen Winter Nelis tree into shape. Let the grower take his shears and go around the tree and examine the difficulty until he is conversant with it, and then commence to prune, not too heavily, though. Cut the limbs that lean too far 'leewards' back a little with an inside bud, and train all future limbs toward the weather side of the tree; cut the limbs this year so the coming buds will form limbs growing in the direction of the weather side of the tree. But use moderation and take your time for it, and don't cut too many big limbs off three-year-old trees—none, in fact, if it can be helped. In bringing limbs to proper place, ropes and stakes can perhaps be used to some advantage in connection with the pruning without interfering with the plowing. Another means which I have found very effectual to use in connection with the pruning is to cut a piece of corn stalk the required length for the intended place, and spread the limb a little, and insert the section of corn stalk endwise between the limb and the body of the tree, and you will have a very good brace, that is easily made, and, being soft, will not injure the tree." —T. E. Owen, Santa Cruz.

These methods will suggest others by which one can bring the most irregular grower into shape. If the tree is cut at planting so as to form the head low, it may be safely left until bearing age for shaping. The tree naturally makes a viny growth of young wood, and the object of leaving it alone is that one limb holds the other more upright until the main limbs become large, or stiff enough to keep the shape; so they may be left, after being thinned out to from three to five limbs, as judgment may direct. Some trees will be best with three or four, others five.

The experience of pear pruning just cited has been secured in regions more or less subject to coast influences. In the hot interior valleys, with the pear as with the apple, care must be taken to prune so as not to open the tree too much to the sun, but to shorten in and thin out only so far as is consistent with maintaining a good covering of foliage.

THINNING PEARS.

It is quite important to attend to thinning the fruit on overloaded trees. Even the popular Bartlett will often give fruit

too small for profitable sale unless thinned. With pears, as other fruits, thinning should not be done until it is seen that the fruit is well set. Dropping off from natural causes sometimes thins the crop quite enough.

BLIGHT OF THE PEAR.

There are blights of the pear occasionally occurring in this State which are not yet fully understood, nor has their identity with the well-known Eastern blights been fully determined, though some growers claim to have recognized characteristic Eastern forms. Fortunately, however, they have not yet proved prevalent.

The smut, which seriously affects some varieties, and notably the Winter Nelis, in the coast region, is identical with the smut of the apple already mentioned on page 239, to which the reader is referred for a remedy which has proved successful both upon the pear and the apple. The accompanying figures are those given by Mr. Klee, and show the effect of the fungus on pear branches; *a* is a young one-year-old twig, showing the effect on leaf and bark, and similar to that on apples; *b*, a two-year-old branch, shows the disease in its secondary stage, such as can be seen in a badly-affected Winter Nelis tree. Because of the liability of the Winter Nelis to this disease, and because of its irregular bearing in the coast region, there have been many trees grafted over into varieties better suited to coast conditions. The Beurre Clairgeau, because of its health, prolific bearing, and acceptability to shippers, has been largely introduced in this way. Ordinary top grafting succeeds admirably with the pear. Clapp's Favorite and other varieties have also been worked upon Winter Nelis.

BLIGHT ON PEAR TWIGS AND LEAVES.

GATHERING AND RIPENING OF PEARS.

Many pear growers make the common mistake of allowing the fruit to hang too long on the tree, instead of gathering and ripening in a cool, dark place. Pears should be picked at the

first indication of ripeness, the first sign being a tendency of the stem to part from the spur when the pear is gently raised up. This test applies especially to the Bartlett. Picking at this stage and laying away in the dark ripens up the Bartlett well. When picked at this stage and sent overland by slow freight, they ripen *en route* and the boxes open well on the Eastern markets. There are a few varieties which shrivel if ripened under cover, but the rule is a good one, and the grower will soon note the exceptions. Many desirable varieties have, no doubt, been pronounced poor and insipid because allowed to ripen on the tree.

To ripen well, pears should be packed in tight boxes or inclosed in drawers. They do not do as well as apples on shelves open to circulation of air. As already stated, the oily-skinned apple endures exposure and maintains a smooth, ruddy cheek and sound heart in spite of wind, rain, and rough weather. The pear, under similar conditions, decays rapidly.

VARIETIES OF THE PEAR.†

Though large collections of famous Eastern and European pears have been brought to California, the peculiarity of the local market, and demand for canning and shipping, has led to concentration upon very few sorts. No doubt, as a better idea of quality in a pear becomes disseminated, and our local markets increase in importance, the pear list will be extended, both by propagation of the good local seedlings which are being brought out, and by wider use of the old standard varieties. At present, however, the pears chiefly grown in California are the following, arranged approximately in the order of their ripening:*

† BLOODGOOD.—(New York.) Tree short, jointed, deep reddish brown wood; fruit medium turbinate, inclining to obovate, thickening abruptly into stalk; yellow sprinkled with russet dots; calyx strong, open, almost without depression; stalk obliquely inserted, without depression, short, fleshy at its base; flesh yellowish white, melting, sugary, aromatic; core small. (See table.)

† BEURRE GIFFORD.—(France.) Tree slender, reddish-colored shoots; fruit medium, pyriform, tapering to stem, which is short; greenish yellow, marbled with red in the sun; calyx closed; flesh white, melting, vinous. The first good early pear. (See table.)

CLAPP'S FAVORITE.—(Massachusetts) Tree a strong grower; young shoots dark reddish brown; fruit large, slightly obtuse pyriform; pale lemon yellow with brown dots; flesh fine, melting, juicy, with rich, sweet, delicate, vinous flavor; resembles Bartlett, but lacks musky flavor. (See table.)

* The descriptions are for the most part condensed from Downing, with local modifications.

† This sign prefixed to the name of a variety signifies that it is free from smut fungus, or only slightly affected.

HARVEST; syn. *Sugar Pear.*—(American.) Small, roundish, pale yellow, brownish in sun, brown and green dots; flesh whitish, rather dry but sweet; tree upright, young wood olive yellow brown. (See table.)

†MADELINE.—(French.) Medium, obovate pyriform, stalk long and slender, set on the side of a small swelling; pale yellowish green, rarely brownish blush; calyx small, in shallow, furrowed basin; flesh white, juicy, delicate. (See table.)

†DOYENNÉ D' ÉTÉ; syn. *Summer Doyenne.*—(Belgium.) Small, roundish obovate, slightly pyriform; smooth, fine yellow, shaded with red, numerous gray or russet dots; stalk short and thick, fleshy at junction with fruit, almost without depression; calyx small, open in shallow, corrugated basin; flesh white, melting, juicy, pleasant. Tree not a fast grower, but healthy. (See table.)

†DEARBORN'S SEEDLING.—(Massachusetts.) Young shoots long, reddish brown; under medium size; roundish pyriform; smooth, clear, light yellow, with few minute dots; stalk slender, set with very little depression; calyx spreading in shallow basin; flesh white, very juicy, melting, sprightly. (See table.)

LAWSON; syn. *Comet.*—(New York.)

SOUVENIR DU CONGRES.—(French.) Large to very large (exceeding Bartlett and Clapp's Favorite, to both of which it bears strong resemblance); skin smooth, bright yellow when fully ripe, brilliant carmine in the sun; flesh resembling Bartlett, but has not the musky flavor, firm to the core; tree a good grower, but somewhat subject to smut. (See table.)

†BARTLETT.—(English.) Tree a strong grower, early bearer, and healthy; fruit large, smooth, clear yellow, sometimes with delicate blush; stalk moderately long, stout and inserted in shallow cavity; calyx open; flesh white, fine-grained, juicy, buttery, highly perfumed (musky), vinous flavor. (See table.)

BEURRE ASSOMPTION.—(French.) Large, irregular; generally oblong pyriform, obtuse, yellow, dotted, marbled and splashed with red in sun; stalk short; calyx large, open; flesh white, half-fine, melting, juicy, rough next the core, acid, sweet; rots first at the core, and is condemned as a shipping pear. (See table.)

†BEURRE HARDY.—"Large, long obovate, sometimes obscurely pyriform; skin greenish with thin, brown russet; stalk an inch long; cavity small, uneven, oblique, basin shallow; buttery, somewhat melting, rich, slightly subacid; tree a strong grower."—J. J. Thomas. (See table.)

†FLEMISH BEAUTY.—(Belgian.) Large, obovate, often obscurely tapering to the crown, very obtuse, surface slightly rough, with some reddish brown russet on pale yellow ground; flesh juicy, melting, and good if picked early and ripened in the house. (See table.)

SECKEL.—(Pennsylvania.) Rather small, regularly formed, obovate; brownish green, becoming dull yellowish brown, with russet red cheek; stalk slightly curved, and set in a trifling depression; calyx small and set in a very slight depression; flesh whitish, buttery, very juicy and melting, with peculiarly rich, spicy flavor and aroma. (See table.)

† DE TONGRES.—(France.) Large, obovate, acute pyriform, somewhat variable; pale yellow, thickly covered with light russet, making it a handsome bronze, and on the sunny side, red; skin thick, but tender, the surface pitted; stem is short and stout, and is inserted more or less obliquely at the summit of the fruit, with no cavity at its base. The core is small, seeds medium size and black; calyx is open; lobes spreading, dry, and leafy; basin shallow; flesh white, firm, rather coarse-grained, sometimes a little dry, but, when in good condition, abundantly juicy; flavor subacid, sprightly, rich, with a peculiar, and to most people agreeable, taste. A vigorous-growing, early, and regular-bearing tree. (See table.)

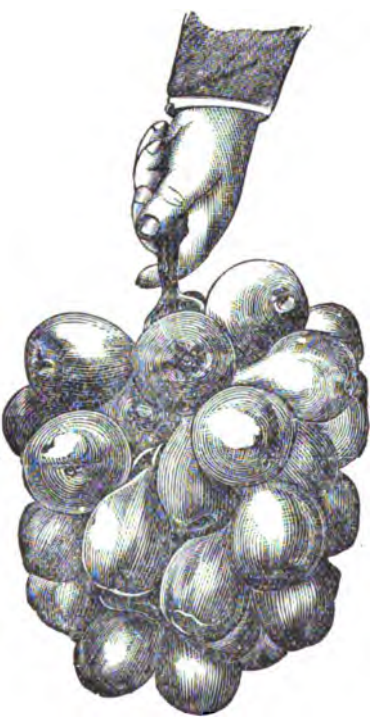
HOWELL.—(Connecticut.) Rather large, roundish pyriform, light waxen yellow, often with finely-shaded cheek thickly sprinkled with minute russet dots and some

russet patches; stalk medium, without cavity and sometimes lipped; sometimes in small cavity; calyx open in large, uneven basin; flesh whitish, juicy, brisk, vinous. (See table.)

†DOYENNE BOUSSOCK.—(Belgium.) Fruit varying in form, obovate, inclining to pyriform or roundish, obtuse obovate; skin rough, deep yellow, clouded with russet, with red cheek; stalk rather short and stout, inserted in a round cavity; calyx open, basin shallow; flesh melting, juicy, sweet, aromatic. (See table.)

DUCHESS D' ANGOULEME.—(France.) Very large, oblong obovate; somewhat uneven, knobby surface; dull greenish yellow, streaked and spotted with russet; stalk long, stout, bent, deeply set in irregular cavity; calyx set in somewhat knobby basin; flesh white, buttery, and juicy, with rich flavor. (See table.)

†LOUISE BONNE OF JERSEY.—(France.) Large, oblong pyriform, a little one-sided; glassy, pale green in shade, brownish red in the sun, numerous gray dots; stalk curved, rather obliquely inserted, without depression, or with a fleshy, enlarged base; calyx open in a shallow, uneven basin; flesh very juicy, and melting, rich, and excellent; very prolific. The adjacent engraving is from a photograph and shows a cluster of fifty-four pears grown in the Briggs' orchard, near Marysville.



CLUSTER OF FIFTY-FOUR LOUISE BONNE PEARS GROWN AT MARYSVILLE.

†BEURRE DIEL.—(Belgium.) Large, varying from obovate to obtuse pyriform; skin rather thick, lemon yellow, becoming orange yellow, marked with large brown dots and marblings of russet; stalk stout, curved in rather uneven cavity; calyx nearly closed, in slightly furrowed basin; flesh yellowish white, a little coarse-grained near the core; rich, sugary, buttery, delicious. (See table.)

†WHITE DOYENNÉ; syn. *Virgalieu.* (France.) Medium to large, regular, obovate; smooth, clear, pale yellow, sprinkled with small dots, sometimes red-cheeked; stalk brown, little curved, in small, round cavity; calyx small, closed in shallow basin; flesh white, fine-grained, buttery, rich, and high flavored. (See table.)

†BEURRE BOSC.—(Belgium.) Large pyriform, a little uneven, often tapering long and gradually into the stalk; skin pretty smooth, dark yellow, dots and streaks of cinnamon russet, slightly red on one side; stalk long, rather slender, curved; calyx short, in shallow basin; flesh white, melting, buttery, rich, with slightly perfumed flavor. (See table.)

ONONDAGA; syn. *Swan's Orange.*—(Connecticut.) Large, obtuse, oval pyriform, neck very short and obtuse, body large and tapering to obtuse apex; flesh melting, sprightly, vinous. A vigorous, upright grower, healthy; yellow shoots; sells well in distant markets. Approved in Alameda County and in the Sacramento Valley.

DIX.—(Massachusetts.) Large, long, pyriform, body round ovate, tapering slightly to the often oblique and slightly flattened and obtuse crown; yellowish green, becoming deep yellow; dots numerous, distinct; stalk one and one-fourth inches, stout at each end, slightly sunk; basin small; flesh rich, juicy, sweet; grown in the Sacramento Valley, and used to some extent in Eastern shipments.

†SHELDON.—(New York.) Medium, roundish, obtuse, obovate; greenish yellow, mostly covered with russet, with slight crimson in sun; stalk short and stout; cavity deep; calyx open in large, broad basin; flesh whitish, very juicy, melting, sweet, aromatic. (See table.)

†BEURRÉ CLAIRGEAU.—(France.) Large pyriform, but with unequal sides; yellow shaded with orange and crimson, thickly covered with russet dots, sometimes sprinkled with russet; stalk short, stout, and fleshy, inserted by a lip at an inclination almost without depression; when lip is absent, the cavity is uneven; calyx open; flesh yellowish, buttery, juicy, granular, sugary, perfumed, vinous. A popular variety for local and distant markets. (See table.)

BEURRÉ D' ANJOU.—(France.) Large, obtuse pyriform; stem short, thick, and fleshy, in a cavity surrounded by russet; calyx small, open in small cavity, russeted; skin greenish, sprinkled with russet, sometimes shaded with dull crimson, brown and crimson dots; flesh whitish, not very fine, melting, juicy, brisk, vinous flavor, perfumed; tree a fair grower, but somewhat affected by fungus. (See table.)

DANA'S HOVEY; syn. *Winter Seckel.*—(Massachusetts.) Small, obovate, obtuse pyriform; greenish yellow or pale yellow, with much russet and brown dots; stalk rather short, a little curved, set in slight cavity, sometimes lipped; calyx open and basin small; flesh yellowish, juicy, melting, sweet, aromatic. (See table.)

†DOYENNÉ D' ALENCON.—Medium roundish, oval, inclining to pyriform; skin rough, yellow, shaded with dull crimson or carmine, with russet patches and brown dots; stalk pretty large, in medium cavity; calyx open, basin deep; flesh somewhat granular, buttery, juicy, sugary, rich, sprightly, perfumed; condemned as a shy bearer by A. Block, of Santa Clara. (See table.)

†VICAR OF WINKFIELD.—(France.) Large and long pyriform; pale yellow, fair and smooth, sometimes with brownish cheek and marked with small brown dots; stalk slender, obliquely inserted without depression; calyx large, open, set in a basin very slightly sunk; flesh greenish yellow, juicy, with good sprightly flavor. (See table.)

DOYENNÉ DU COMICE.—(France.) Large, varying, roundish pyriform, or broad, obtuse pyriform; greenish yellow becoming fine yellow, shaded with crimson, slightly marked with russet spots, and thickly sprinkled with russet dots; stalk short, stout, inclined and set in shallow cavity, often russeted; calyx small, open; basin large, deep, and uneven; flesh white, fine, melting, aromatic. (See table.)

GLOUT MORCEAU.—(Flemish.) "Rather large, varying in form, but usually short pyriform, approaching obtuse oval; neck very short and obtuse; body large and tapering towards the crown; often considerably ribbed; green becoming pale greenish yellow; stalk stout, moderately sunk; calyx large; basin distinct, rather irregular; flesh white, fine-grained, buttery, melting, rich, sweet, and of fine flavor."—J. J. Thomas. (See table.)

LAWRENCE.—(New York.) Medium size, lemon yellow, with minute brown dots; flesh whitish, juicy, melting, and rich; grown for shipment to some extent on the Sacramento River. Approved in Butte County.

BEURRE GRIS D' HIVER NOUVEAU.—(France.) Medium, roundish, obtuse pyriform; golden russet, with red cheek, and sprinkled with dots; stalk very stout, rather short, inclined; sometimes in large cavity, sometimes lipped; calyx very small and open; basin shallow, uneven; flesh somewhat granular, juicy, buttery, melting, rich, and sugary, with peculiar aroma. "Size large to very large; tree a good regular bearer; quality very good."—W. G. Klee, Alameda County. Unfavorably reported by A. Block, of Santa Clara. (See table.)

WINTER NELIS.—(Belgium.) Medium, roundish, obovate, narrowed in near the stalk; yellowish green, dotted with gray russet and a good deal covered with russet; stalk rather long, bent, and set in narrow cavity; calyx open in shallow basin; flesh yellowish, white, fine-grained, buttery, very melting, and full of rich, sweet, aromatic juice. (See table.)

EASTER BEURRÉ —(France.) Large, roundish, obovate obtuse; often rather square in figure; yellowish green, sprinkled with many russet dots and some russet patches; stalk rather short, stout, set in an abruptly sunken, obtuse cavity; calyx small, closed, but little sunk among plaited folds of angular basin; flesh white, fine-grained, very buttery, melting, and juicy, sweet, rich flavor; was successfully shipped from California to England as early as 1872. (See table.)

B. S. FOX—A CALIFORNIA SEEDLING.

POUND.—Large, pyriform; yellowish green with red cheek; esteemed for cooking; reaches enormous size in this State as already noted. (See table.)

KIEFFER AND LE CONTE.—These pears, recently introduced as especially hardy varieties, are grown to a limited extent in all parts of the State, but are usually condemned as inferior to the European varieties which attain such excellence in this State.

CALIFORNIA SEEDLING PEARS.

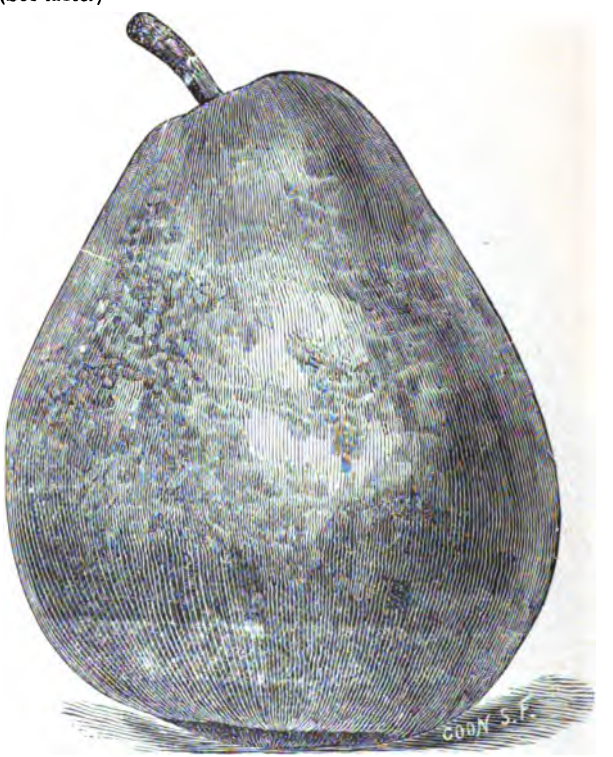
California propagators have not paid so much attention to the production of seedling pears as of other seedling fruits, and

yet notable results have been attained by a few. The late B. S. Fox, of San Jose, was our most intelligent and zealous worker in this direction, and his seedlings are attaining the eminence which he expected for them. Three are prominent, of which descriptions from Downing's Appendix II, pages 146, 152, and 154, are given herewith:—

P. BARRY—A CALIFORNIA SEEDLING.

B. S. Fox.—(California seedling by B. S. Fox.) Described by Downing in his Appendix II. Fruit large, oblong, obtuse pyriform; skin clear, bright yellow, nearly covered with rich, golden russet; stalk rather short, stout, inserted obliquely by a lip in a slight depression; flesh whitish, fine, juicy, melting, sweet, rich, and excellent. "A good grower, bearer, and shipper. September to October."—California Nursery Co.

P. BARRY.—(California seedling by B. S. Fox.) Fruit large, elongated pyriform, a little obtuse; skin deep yellow, nearly covered with a rich golden russet; stalk of medium length and thickness, set rather obliquely on a medium cavity, sometimes by a lip; flesh whitish, fine, juicy; melting, sweet, slightly vinous, and rich. "An early and prolific bearer. December to January."—California Nursery Co. The pear, P. Barry, is recommended for planting, by the Southern California Nurserymen's Association. It is coming into wide favor in the near coast regions, as it does not blight, and is approved in the interior valleys. It is expected that the Barry will displace the Winter Nelis as a more healthy tree and a more certaian bearer. (See table.)



COLONEL WILDER—A CALIFORNIA SEEDLING.

COLONEL WILDER.—(California seedling, by B. S. Fox.) Fruit medium to large, roundish obtuse pyriform; skin light yellow, a shade of light orange red in the sun; slight nettings of russet, and numerous small russet and brown dots; stalk rather short; flesh whitish yellow; a little coarse around the core; juicy, melting, very sweet, with a peculiar slight musky and slightly aromatic flavor. "This will undoubtedly prove a first-class very late variety. December to January."—California Nursery Co.

R. D. Fox, in an article in the *Rural Press*, November 24, 1883, says these varieties originated from seed of Belle Lucrative; they were in bearing in 1873. Mr. Fox grew scores of seedlings, but considered these only worth perpetuating. They received Wilder medals from American Pomological Society, in 1875 and 1881.

BLOCK'S ACME.—(California seedling, by A. Block, of Santa Clara.) Large and very handsome, surpassing Beurre Clairgeau in size and color; regularly formed, pyriform; skin pale yellow, covered with russet all over, which becomes a fine, glowing red on the side exposed to the sun; flesh white, crisp, and melting, juicy, sweet, and slightly musky; a pear that will rank foremost with our best shipping pears.

BLOCK'S SUPERB.—(California seedling, by A. Block, of Santa Clara.) Medium size, roundish obovate; skin greenish yellow, covered with patches of russet and dots; flesh yellowish, fine-grained, melting, with a rich, sugary and vinous flavor; a pear that will come in line with our best autumn pears.

The above descriptions were drawn by John Rock, Leonard Coates, and I. A. Wilcox, as a Committee of the California State Horticultural Society. Mr. Block was awarded a Wilder medal for his seedling pears, by the American Pomological Society, in 1885. The Acme was awarded a premium at the Mechanics' Institute Fair, in 1887.

KENNEDY.—(California seedling, originated on Rancho Chico, and first brought to notice by D. H. Lennox, nurseryman to General Bidwell.) Description by W. G. Klee: "Size, medium or a little below; length and width, from two and one-fourth to two and three-fourths inches; general shape, only slightly elongated, and always more or less irregularly angular or partially flattened in cross section, while the longitudinal section is quite regular, showing the greatest diameter at about three-fifths of the length; stem, one and one-eighth inches long, curved, rather stout and club-shaped, with a constriction where attached to a mamillary basil projection, which is also surrounded by a furrow at least half way round; flower end with a rounded basin, from which the partly fleshy calyx lobes rise just to a level with the surrounding ridge; skin roughish, wholly or partly russet, like the Winter Nelis; flesh tender, somewhat granular, especially around the core, very sweet and juicy, and well but not excessively flavored; carpels, four or five, mostly with two perfect seeds each; an angular cavity one-half to five-fifths inch in length in the axis; in excellent condition October 11; a few just beginning to soften, but uniformly throughout, firmest nearest the core." "Superior to Bartlett or Winter Nelis in flavor, and ripens between the two."—G. M. Gray.

SANTA ANA.—"Originated in town of same name, in Los Angeles County. Large, conical pear; bright golden yellow covered with russet; exceedingly handsome; flesh fine-grained and free from woody substance; flavor equal to Winter Nelis or Seckel; good from the tree and yet will keep all winter; shipping and keeping qualities cannot be excelled."—W. R. Strong & Co., 1887.

THE IDAHO PEAR.—Originated from seed sown by Mrs. Mulkey, of Lewiston, Idaho, and propagated by the Idaho Pear Co., of that place. Described by J. J. Thomas: "Large, nearly globular, obtusely ribbed, light rich yellow with numerous small dots; cavity very deep and narrow, and strongly furrowed; stem small for so large a pear; basin very deep and furrowed; calyx closed; flesh fine-grained, buttery and melting, with very good flavor."

NAPA SEEDLING.—"Very large; similar to Duchess d' Angouleme; very thrifty; October and November."—Leonard Coates, 1886.

SANTA ROSA SEEDLING.—"Originated on the place of Dr. McAnnally, in Santa Rosa, and propagated by Luther Burbank; said to resemble the Vicar in size and shape, and the Bartlett in flavor; ripens late, remaining on the tree until November."—*Rural Press*, Dec. 29, 1883.

PEARS IN THE UNIVERSITY ORCHARD.

The University of California has, at Berkeley, Alameda County, a large collection of pears. The growth of the trees and the character of the fruit has been systematically observed and noted for several years, and the data secured is of value to pear growers. Professor Hilgard's report for 1887 contains tables which give in condensed form the records made by W. G.

Klee, who was in charge of the orchard for several years. All this information may be had by securing a copy of the report from Prof. E. W. Hilgard, Berkeley, Cal. Scions can also be had for grafting or budding, the applicant being charged only the postage thereon.

The following varieties not generally grown in this State are considered by Mr. Klee especially worthy of trial. Those which have withstood the blight, and are, therefore, presumably adapted to coast regions, are marked with an asterisk (*). Exceptions to this rule are noted in the text. The time of ripening at Berkeley is given, which is, of course, late, as compared with he interior.

Annie Ogereau.—Very handsome; beginning of August.

Ott.—Middle of August, before Seckel; small, but delicious.

Duchesse Precoce.—Above medium; a steady bearer; fair quality; end of July.

**Doyenne Robin.*—Medium to large; beginning of September; good bearer; fair quality; excellent keeper.

Dr. Reeder.—Small, but of the highest quality; end of September, beginning of October, after Seckel.

**Paradise d' Autumne.*—September and October; medium size; very good.

**Marie Louise d' Uccles* —End of September; small grower, but a large and constant bearer; fruit large; good quality.

**Conseiller de la Cour.*—Large; regular bearer; good; middle of October.

**Jalousie Fontenay Vendee.*—Medium; good bearer; resembles in taste Beurre Gris, of Europe.

**Pitmaston Duchesse d' Angouleme.*—A pear entirely different from the ordinary Duchesse; is later; large to very large; so far a shy bearer; good.

**Baron de Mello.*—Medium; regular bearer; November; good.

Augustus Dana.—Large; November; very good; so far a shy bearer.

**Md. Lariol de Barny.*—Large, good bearer; good.

**Jaminette.*—Above medium size; November and December; excellent keeper; good (extremely sweet).

Fondante de Noel.—Above medium; very handsome; December; good.

**Jones' Seedling.*—Small; a good, steady bearer; October; good.

Duhamel de Monceau.—December; above medium; very good; tree a poor grower.

Forelle or German Trout Pear.—A fall pear of great beauty.

**Louis Vilmorin.*—Large pear resembling Clairgeau. Not adopted to coast climate; should be tried elsewhere; tree healthy and yield fair

Beurre Superfin.—Medium roundish, pyriform; fair grower; fruit rich and delicious; keeps fairly.

PEARS COMMENDED FOR SOUTHERN CALIFORNIA.

The Southern California Nurserymen's Association commends the following pears: Bartlett, Flemish Beauty, Winter Nelis, Easter Beurre, Beurre Hardy, Beurre Clairgeau, Beurre Bosc, Clapp's Favorite, Seckel, Vicar of Winkfield, Doyenné d' Alencon P. Barry.

TABULAR STATEMENT OF ADAPTATIONS.

Upon the two following pages are tables showing adaptations of varieties to the counties named, the compilation being governed by the conditions already described in connection with other fruits.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS, NAMING VARIETIES OF THE PEAR MOST SATISFACTORY IN THE COUNTIES SPECIFIED.

COUNTIES OF CALIFORNIA.	Harvest	Madeleine	Doyenné d'Eté	Bloodgood	Beurre Gifford	Clapp's Favorite	Dearborn's	Souv d'u Cong's	Bartlett	Beurre Assomp'n	Beurre Hardy	Flemish Beauty	Seckel	De Tongres	Howell	Doyenné Bous'k	Duch'se d'Ang'e
Del Norte									*		*						
Humboldt	*					*	*		*		*		*				
Mendocino					*				*		*						*
Lake		*					*		*		*	*					*
Napa		*			*		*	*	*		*	*	*	*			*
Sonoma						*	*	*	*		*	*	*				*
Marin									*		*						
Contra Costa		*	*	*	*		*	*	*		*		*				*
Alameda		*	*	*	*	*	*	*	*	*	*	*	*	*	*		*
Santa Clara		*	*	*	*		*		*		*	*	*				*
San Mateo		*	*				*		*		*	*	*				
Santa Cruz		*					*		*		*	*	*				
San Benito					*				*		*	*	*				*
Monterey									*		*	*	*				
San Luis Obispo									*		*	*	*				
Santa Barbara		*				*			*		*	*	*				
Ventura						*			*		*	*	*				
Los Angeles		*				*		*	*		*	*	*				*
San Diego									*		*	*	*				
San Bernardino		*		*		*			*	*	*	*	*				*
Kern									*			*	*				*
Tulare		*							*			*	*				*
Fresno									*								*
Merced						*		*	*				*		*		*
Stanislaus									*				*				
San Joaquin		*					*		*		*						
Sacramento		*		*			*		*		*	*	*		*		*
Solano		*				*		*	*		*						*
Yolo		*			*	*	*		*		*						*
Sutter									*								
Yuba									*								*
Butte		*			*	*			*		*		*				
Colusa	*								*								
Tehama									*								
Shasta		*	*	*					*			*	*				
Trinity									*								
Siskiyou									*								
Modoc									*								
Lassen																	
Plumas									*			*					
Sierra									*				*				
Nevada									*								
Placer							*		*			*	*				*
El Dorado	*	*			*				*		*						
Amador									*				*				
Calaveras									*			*	*				
Tuolumne								*	*			*	*				*
Mariposa									*								
Alpine																	
Mono		*							*								
Inyo																	

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS NAMING VARIETIES OF THE PEAR CONSIDERED MOST SATISFACTORY IN THE COUNTIES INDICATED.

COUNTIES OF CALIFORNIA.	L'se Bonne de J	Beurre Diel	White Doyenné	Beurre Bosc	Sheldon	Beurre Clairgeau	Beurre d' Anjou	Dana's Hovey	Doy. d'Alencon	Vicar of W'kfield	Doy. du Comice	Glout Morceau	B're gris d' hiv'r	Winter Nelis	Easter Beurre	P. Barry	Pound
Del Norte	*		*											*			
Humboldt										*				*	*		
Mendocino							*							*	*		
Lake	*						*							*	*		
Napa		*	*			*	*	*				*	*	*	*	*	*
Sonoma						*								*	*		
Marin														*	*		
Contra Costa		*				*								*	*	*	
Alameda	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*
Santa Clara		*	*			*	*	*		*	*	*		*	*		
San Mateo														*	*		
Santa Cruz		*				*			*	*		*		*	*		
San Benito						*						*		*	*	*	
Monterey	*		*			*	*					*		*	*		
San Luis Obispo										*				*	*	*	
Santa Barbara						*			*	*				*	*	*	
Ventura				*		*			*	*				*	*	*	
Los Angeles				*		*			*	*				*	*	*	
San Diego	*			*		*			*	*		*		*	*	*	
San Bernardino	*	*		*	*	*	*		*	*				*	*	*	
Kern														*	*		
Tulare			*							*		*		*	*		
Fresno				*				*		*				*	*	*	
Merced														*	*		
Stanislaus														*	*		
San Joaquin							*					*	*	*	*		
Sacramento							*			*		*		*	*		
Solano			*					*		*		*		*	*		
Yolo			*	*		*	*		*	*				*	*		
Sutter														*	*		
Yuba												*		*	*		
Butte			*	*		*		*						*	*		
Colusa														*	*		
Tehama														*	*		
Shasta					*							*		*			
Trinity														*			
Siskiyou														*			
Modoc														*			
Lassen				*										*			
Plumas														*			
Sierra														*			
Nevada														*	*		
Placer			*			*	*	*		*				*	*		
El Dorado							*							*	*		
Amador			*							*				*	*		
Calaveras															*		
Tuolumne			*			*				*							*
Mariposa																	
Alpine																	
Mono																	
Inyo			*		*	*								*			

CHAPTER XXII.

PLUMS AND PRUNES.*

THE plums of California are exceptionally fine in appearance and of high quality. Both tree and fruit have thus far escaped the parasites which have wrought greatest injury on the eastern side of the continent. The curculio has never been found here, and the "black knot," though detected in some of the indigenous species of the genus *prunus*,† has never been observed in our orchards. The tree suffers, it is true, as do most other fruit trees, from minute pests infesting bark and leaf, but their work is a light affliction compared with the ravages of the curculio and black knot which Eastern plum growers have to contend against. Including the large planting of the last few years, the plum stands second only to the peach among the fruit trees of California. Of the plums, at least four-fifths are those varieties designated as prunes, and the preponderance of prunes is rapidly advancing. This is, of course, owing to the profitable shipping demand for our prune product, while ordinary dried plums have not generally commanded good prices. There is, however, a growing trade at the East in our fine plums in a fresh state. Some varieties stand shipment well, and are large and handsome. The work of the curculio at the East opens the way for our fruit. By choosing varieties ripening in succession, the plum season extends from May to December, thus enabling the California plum grower to strike the Eastern markets both early and late. There is also a considerable demand for plums by the canners, and some varieties not usually called prunes, but dried as prunes, sell well.

LOCALITIES FOR THE PLUM.

The plum has an exceedingly wide range in California. The trees are thrifty and profitable even from the immediate vicinity of the coast, and in coast valleys, where the sea winds

*The prune is only a plum, having the property of drying and curing without the seed being removed. and making a superior dried fruit.

†Found on *prunus demissa*, in Yo Semite Valley and in Coast Range in San Mateo County, by Dr. H. W. Harkness. Report State Board of Horticulture, 1883, pp. 54, 55.

and fogs intrude, eastward across the great interior valleys, and upwards upon the sides of the Sierra Nevada. In the upper half of the State, at least, wherever there is sufficient moisture in the soil, good plums can be grown. The wide distribution of the native plum, as noted in the chapter on our wild fruits, seems to welcome the improved varieties to similar distinction on the uplands, and the earliest plantings in the valleys demonstrated also the adaptation of the fruit to the lowlands. The tree is quite hardy, but in situations open to sweep of the winds there has been found to be decided advantage in belts of sheltering trees for protection. At some points subject to direct coast influences, there is sometimes loss by cracking of the fruit. Only certain varieties are thus affected, and they can be avoided where the trouble is found to exist.

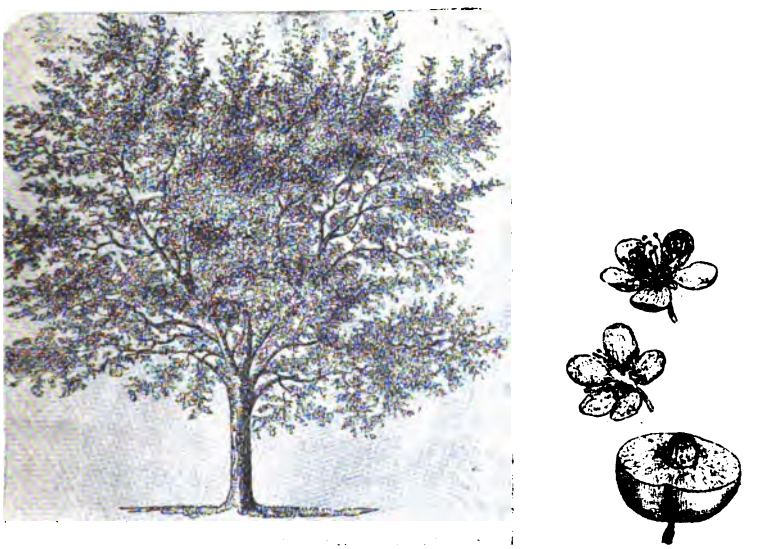
It was for a long time held that Southern California was not adapted to the growth of the plum, but the experience of the last few years has shown that the conclusion was too broad. The "French prune" has demonstrated its success adjacent to the coast in Santa Barbara County and elsewhere, in the low, rich lands of the Santa Ana Valley, of Orange County, in the interior at various points on the rim of the San Gabriel Valley, in Los Angeles County, notably at Pomona, and still farther inland at points in the San Bernardino Valley. Other varieties of plum also succeed in the regions named, and under similar situations, and though possibly all conditions of success may not yet be known, there seem to be no natural barriers to the success of the fruit if the trees are properly handled by the grower. No doubt the arrangement of proper moisture conditions is important. The tree should be helped to make one good growth and to ripen its wood in the fall. To have growth checked by drought and a second start made later in the season is not desirable. One intending to grow plums at the South should confer with older residents, and thus get the results of local experience, and proceed accordingly.

SOILS AND STOCKS FOR THE PLUM.

With the plum, as with the apricot, the subjects of soils and stocks are intimately related, but the whole matter has been wonderfully simplified by the experience of the last few years. This relief has come through the adoption of the Myrobolan, or cherry plum (*Prunus Myrobalana*) as a general all-around stock for plums and prunes. Before this practice was taken up the effort to grow the plum on its own roots generally resulted in getting an orchard full of suckers, and to avoid this, plums were worked on peach roots wherever this root would succeed in the

soil to be planted. But some varieties of plums do not take kindly to the peach, and then "double working" (putting first on the peach a plum which is known to take well and then on that plum wood the variety desired) was followed. The use of the Myrobolan does away with the suckering nuisance and the need of double working.

There has been considerable discussion during the last few years as to what is the true Myrobolan, and it must be acknowledged that some of the refined distinctions which have been mooted do not seem to be well placed. Seedlings grown from



THE MYROBOLAN PLUM—BLOOM AND FRUIT.

the seed of the Myrobolan vary as do other fruit seedlings, both in fruit and in foliage and habit of trees, and perhaps this fact has given rise to the distinction between "true" and "false" Myrobolan, so called. Practice has proceeded without much reference to the discussion, and whether grown here, from seed of trees imported long ago, or from cuttings of the same, or whether seedling stocks are imported directly from France, as large quantities are, the Myrobolan of French origin is now the accepted plum stock for California, except in light alluvial, well-drained soils, where the Peach is preferred. The Myrobolan has largely displaced the St. Julien and the Mirabelle, as well as the Peach. Though described by some authorities as a dwarfing stock, it is found to be sufficiently free growing in California to

suit all purposes, and to form a good foundation for full standard trees, though the Peach root in proper soils gives a quicker and greater growth. Such prominence has been attained by the stock that we introduce from the London *Garden* an engraving of the typical Myrobolan tree. Its leaves are smaller and its shoots finer than the cherry plum tree grown for its fruit in this State.

Whether Myrobolan shall be grown from seed or from cuttings is an open question in California practice. Large quantities have been grown from cuttings, as is the French practice, according to Baltet.* Other propagators hold, with W. H. Pepper, of Petaluma, that plum cuttings "form a mass of fibrous roots at the lower end of the cutting, and when transplanted fail to send out strong supporting roots. I see no need of using plum stocks grown from cuttings when first-class seedling stocks can be bought for $10 or $12 per thousand." As for the durability of trees grown from cuttings, there can easily be found old, thrifty orchards planted with such trees, though it must be acknowledged a better root system would be expected from a seedling, and there are instances in which trees from cuttings are held to be diseased in the root, while seedling roots are healthy. Possibly longer experience may yield a demonstration of the question. The growth of Myrobolan stocks from cuttings is described on page 106.

Experience has shown that the Myrobolan stock thrives in this State both in low, moist, valley lands, in comparatively dry lands, and in stiff upland soils. Thus it has come to be accepted as an all-around stock for the plum.

In some soils especially adapted to the peach, peach roots are preferred as stocks for the French prune, but, as already said, all plums cannot be worked directly on the peach root, the Columbia, Yellow Egg, and Washington, for example. Sometimes the bud or scion may make a large growth, but the two woods do not unite, and the trees break off sooner or later.

Some work the plum on the apricot root, and report success when the soil suits the apricot root, and the gophers do not get at it. But it sometimes happens that the French prune parts from the apricot root even after growing some time upon it. There are, however, instances of the French prune thriving, and, apparently, making good union with the apricot root.

Some plums do well on the almond root and some do not. The French prune succeeds admirably both when worked on young almond stocks and top grafted in old almond trees. Success is also reported with the Fellenberg on the almond. But the almond root is suited especially for warm, dry soils.

*"Grafting and Budding," p. 199.

Excellent results from the use of almond stock are reported from the Sierra foot-hills. Thus it appears that choice of stock should be made according to soil, but unless it is known that there is some local advantage in the use of other stock, the Myrobolan should be used. This brings the plum on its own root, and enables the planter to grow good plums on stiff clay soil, on shallow loam with a clay subsoil, and in situations which are too wet for most other fruit trees. The plum root will also stand more alkali than any other fruit save the pear. But though the plum will endure harsh surroundings, it enjoys the good things of the earth and returns fruit accordingly. A rich clayey loam seems to best suit the plum tree.

PROPAGATING BY SPROUTS.—The French practice of growing certain varieties of the plum by means of sprouts from the base of old trees has been successfully followed in this State by Felix Gillet, of Nevada City, and is strongly commended by him as securing a tree which will not gum, which is one of the reasons why the same practice prevails in France. Mr. Gillet says that in the prune district of France two-thirds of the trees are grown from sprouts and one-third by budding or grafting on other roots. This practice is as follows:—

Sprouts growing at the foot of old and large trees, and but few are found to each tree, are taken off and planted close together in a bed to make them root well, and the ensuing spring planted in nursery rows, where they are trained like any other trees, and transplanted where to remain, when branched.

PLANTING AND PRUNING.

As with other trees, there is difference of opinion as to the best distance apart for plum trees. The present tendency is toward wider planting, and not nearer than twenty feet is the usual advice.

The plum, in California, is a most rapid grower; six to ten feet from the bud or graft in a season, and about as much after the first winter's cutting back, is not at all unusual. At this rate of progress, then, the tree soon runs up and away, in a spindling, sprawling fashion, unless severely cut back for the first few years. Neglected trees show long, streaming branches, arching outward, and exposing the bark to sunburn (to which it is very sensitive), breaking the tree to pieces as the fruit gets weight, and, even if supported by props, breaking off at the bearing of the prop. This condition of the tree can only be obviated by low heading and cutting back each year, throwing strength into the stem and branches, as has been described in the chapter on pruning, and in connection with the other fruits already considered.

The general vase form is the best model for the plum tree, but it will do well to form it with more branches than other trees. In an address before the Fruit Growers' Convention in 1886, W. H. Aiken, of Wrights, Santa Clara County, advised the shaping of the plum tree as follows:—

Cut back the trees, after planting, to eighteen inches from the ground, and shade on south side by some convenient shade. Three or four buds should be allowed to grow at the top, and the terminal buds of those which start below pinched back, after they have grown out a little, so that the buds will put out leaves and shade the stalk the first year. The second year remove them and cut back the limbs to a foot in length; the third year cut off all but two feet of the new wood, etc.—the object in view being to shape a handsome tree with strength and bearing space, which can be attained only by low training and intelligent pruning.

It is important in pruning to select buds on the upper side of limbs, as they will have a greater weight-bearing power than buds forming branches from under side of boughs. Summer pruning is not advisable; a full season's growth, properly pruned back in the winter and trained low so that the branches take a natural upward and oblique direction, will shape a tree that will be strong and broad enough to live long and be fruitful.

My idea of pruning the prune or the plum tree is to make a handsome tree with plenty of limbs, and prune it back so that it will give the limbs great strength and bearing space. In that way you can raise a large amount of good plums or prunes.

Do not thin out much, because, when it begins to bear, the tree opens very nicely. I have eight year-old French prune trees, and though they didn't average it, many of them had eight hundred pounds of prunes on this year without much affecting the form or the shape of the tree. They were pruned to secure such a broad bearing space that they bore that amount of prunes very easily.

PRUNING THE FRENCH PRUNE.—How long the system of shortening should be followed is just now a matter of controversy. The conflict of opinion on the subject in the Santa Clara Valley was curiously brought out in a case at law in the Superior Court of that county. The defendant had agreed to pay a certain lump sum for the coming crop of a certain prune orchard. He did not fulfill his contract, and when sued by the plaintiff, set up, as one point in his defense, that the orchard had been pruned too short, hence the crop was decreased. Thus the whole question of pruning was brought into court, and experts (prominent fruit growers of the valley) were examined. In his decision* for the plaintiff the judge made the following reference to the pruning of the orchard:—

Witnesses for the defense all agreed that the trees were pruned excessively short, and that the failure of the crop was owing to this cause. The reasons assigned by these witnesses are these: That by short pruning, in the first instance, many buds are cut off which would and should be permitted to produce fruit. Further, that by such short pruning the remaining buds are unduly stimulated and an excessive growth of wood and twigs is produced at the expense of the fruit.

Witnesses for the plaintiff all testified that the orchard had been properly pruned. It further appears from the testimony of all the witnesses that there are two systems or modes of pruning in vogue, and that each has a numerous school of followers; that the witnesses called by the defendant favor the long method, by which

* In full in San Jose *Mercury*, Aug. 1, 1885.

one-third or even less of each year's growth is cut off, while the other class, represented by plaintiff's witnesses, remove two-thirds or three-fifths of the yearly growth; that the merits of the two systems have been the subject of much debate and of much experiment, and that both methods are extensively practiced and advocated. The witnesses, farther, all agree that the course to be adopted would be largely dependent upon the age, the growth, and the vigor of the trees, and that the results might be affected or materially modified by the character of the season.

The case was not decided upon the pruning, but the extracts given show quite a difference of opinion between Santa Clara County growers as to the extent of "shortening in" of bearing prune trees.

During the last few years this issue has progressed with the advantage in favor of those who advocate less shortening in after the tree comes in bearing than was formerly in vogue, and the claim for sparing the knife rests upon the observed amount and character of the fruit by the two methods. The question is a broad one, and includes trees in the interior as well as in the coast valleys. At the Fruit Growers' Convention of 1885, I. H. Thomas, of Visalia, told of an experiment he had been watching for three years at Fresno. Of two blocks of seven-year-old French prune trees one was cut back close each winter and the other not pruned except to cut out cross limbs. The pruned block yielded but little fruit; the other bore heavily. From this observation Mr. Thomas concluded that he would not do much pruning of the French prune after getting it in good shape as a three-year-old.

Mr. Hatch, of Suisun Valley, is following the practice of cutting back four years for shape, then letting the tree go unpruned and into fruit for one year, and the following winter cut back to within twelve or fifteen inches of the previous cut.

Dr. W. J. Dobbins, of Vaca Valley, is following this method: Instead of taking off one-half of the new growth on a four-year-old prune tree, he lets it go unpruned, and it will throw out fruit spurs up to the top of the shoots, where only a short terminal growth will be made. The next winter he cuts off all the new growth and part of the old. He believes prune and pear trees will do better by being shortened in every second or third year after coming into bearing, but this rule will not hold with the peach or apricot.

These methods are as yet but experimental, and are given as such. They are, however, the outgrowth of much observation on the behavior of the French prune tree, and the future will demonstrate whether they are best to reach desired ends. It is obvious from what was said at the outset, with reference to the growth of the tree, that care must constantly be had to keep the tree symmetrical and strong, and to guard against disaster from overgrowth.

How far desirable ends can be reached by summer pruning is not yet demonstrated. It is practiced by some growers on bearing trees, but never on young trees. The danger with it is that it is apt to overact and secure excessive weight of inferior-sized fruit. Thinning out the tree is seldom needed; rather is the retention of all foliage and shade desirable.

SPECIAL STUDY OF VARIETIES IN PRUNING.—The points just advanced apply especially to the management of the French prune. How far other varieties may be benefited by it must be determined by the grower by study of the habit of the variety he has to deal with. The general rules for handling trees with different habits of growth are applicable to a certain extent to the plum. When to apply a rule or make an exception must be learned by observation and experience.

VARIETIES OF PLUMS AND PRUNES.

As with other fruits, comparatively few varieties of the plum are largely grown in California, and the list is continually being reduced. The demand for shipment to the East is leading to trial of various new sorts which ripen very early, and some local seedlings are promising well in this respect. For later sorts, varieties which are showy and stand transportation well are preferred to those more tender and of higher quality.

The acreage of prunes is rapidly increasing, and though other sorts are locally popular, the French prune (*prune d'Agen*) is the universal favorite, and has shown a most fortunate adaptation to Pacific Coast conditions, extending in its range from the coast to the Sierra, and from Southern California northward into Oregon.

In the descriptions of Eastern and European standard varieties, which will follow, the new edition of J. J. Thomas' "American Fruit Culturist"* is the basis, but local observations are inserted, especially as to size and quality, when demanded by California experience.

CADDO CHIEF.—"An exceedingly early plum, ripening with Early Richmond; cherry; medium size, firm; dark red."—John Rock. Approved by W. A. Sanders, Fresno County.

CHERRY.—"Very early, medium-sized, pale red; sweet, juicy, and subacid."—John Rock. Early shipments from Marysville and Vaca Valley sell well. Has been shipped from latter region as early as May 10. Tree very prolific. (See table.)

EARLY GOLDEN DROP.—"Small, bright yellow, sugary and rich; separates freely from the stone. Early July."—John Rock. Approved in Napa and San Benito Counties

* Published by William Wood & Co., New York.

PEACH.—(French, *prune pêche.*) Very large, roundish oblate, regular, flattened at ends; suture distinct shallow; color varying from salmon to light brownish red; stalk very short, cavity narrow, shallow, flesh rather coarse, juicy, sprightly, free from the nearly round, very flat, much furrowed stone; shoots smooth. A prominent variety for early Eastern shipment. (See table.)

IMPERIAL OTTOMAN.—Medium, oval suture on one side half way from base to apex; pale greenish yellow, marbled, very juicy, sweet, excellent; very hardy. Approved in Siskiyou County.

WILD GOOSE.—Medium, roundish, oblong, bright scarlet; a good variety of Chickasaw plum; hardy and productive.

ROYALE HATIVE.—(French.) Medium roundish, slightly wider at base; light purple, stalk half an inch long, stout, scarcely sunk; flesh amber yellow, with rich, high flavor, nearly free from the small, flattened, ovate stone; shoots very downy. Largely grown as an early market plum and for Eastern shipment. (See table.)

PRUNUS SIMONI.—(Chinese.) Large, flattened, with deep cavities at base and apex; brick red or dark cinnabar color; stem very short, flesh fine, apricot yellow, with peculiar aromatic flavor; tree small, with large, long, oval elliptic leaves of dark shining green; flowers small, white; reaches its highest perfection in hot, dry summer air. (Condensed from Professor J. L. Budd.) "Light green branches of *Simoni* grow as vigorous and upright as the Bartlett pear, and are heavily clothed with unusually long, narrow, light green leaves."—Luther Burbank, Santa Rosa. "Very fine as an early plum; ripens with Royale Hative, and ships well; large, six and a quarter to seven inches circumference; flesh firm, rich, sweet, aromatic, delicious, with marked pineapple and faint banana flavors; pit very small."—I. H. Thomas, Visalia. Approved in Napa, Sonoma, and Tulare Counties.

PRUNUS SIMONI.

BRADSHAW.—Large, obovate, with obtuse suture on one side, sometimes with very slight neck; dark purple, with light blue bloom; stalk three-fourths inch long; cavity narrow; flesh a little coarse, becoming light brownish purple, at first adhering, but becoming nearly free when fully ripe; juicy, good, slightly acid; tree vigorous; shoots purple, smooth. Reported from Sacramento County as blooming late and seldom injured by frost. (See table.)

GREEN GAGE.—(French.) Rather small, round; suture faint green, becoming yellowish green, usually with reddish brown dots and network at base; stalk half to three-fourths inch, scarcely sunk; flesh pale green, melting, juicy, exceedingly rich, and flavor excellent; shoots smooth. (See table.)

DUANE'S PURPLE.—(New York.) Very large, oblong oval, longer on one side; slightly narrowed towards the stalk; reddish purple, bloom lilac; stalk three-fourths inch; slender; cavity narrow; flesh juicy, moderately sweet, and moderate flavor, mostly adhering to stone; shoots very downy and leaves large and downy beneath. (See table.)

MCLAUGHLIN.—(Maine.) Large, roundish oblate, much flattened at ends, suture obscure; stalk three-fourths inch, scarcely sunk; skin thin, tender, russet yellow sprinkled with thin red, purplish at base; flesh rather firm, juicy, sweet, luscious; shoots smooth; leaves large and glossy.

WASHINGTON.—(New York.) Very large, roundish oval, suture obscure, distinct at base; yellowish green, faintly marbled, often with pale red blush; stalk half to three-fourths inch; slightly downy; cavity wide, shallow; flesh rather firm, sweet, mild, very rich and luscious, free from the pointed stone; shoots downy; very vigorous. (See table.)

YELLOW EGG; syns. *White Egg, White Magnum Bonum.*—(English.) Very large, oval, narrow at ends, necked at base, suture distinct; stalk one inch, not sunk, surrounded by fleshy ring at insertion; light yellow, bloom thin, white, flesh firm, rather acid until fully ripe, and then sweet, adheres to the pointed stone. (See table.)

LOMBARD.—(New York.) Medium to large, round oval, slightly flattened at ends, suture obscure; violet red, stalk half to three-fourths inch, very slender, cavity broad; flesh deep yellow, lacks quality; hardy; shoots smooth and glossy, light purple. Approved in Monterey and Butte Counties.

JEFFERSON.—(New York.) Large, oval, base slightly narrowed, suture slight; greenish yellow, becoming golden, with reddish cheek; bloom thin, white; stalk one inch, but little sunk or not at all; flesh rich yellow, very rich, juicy, high flavored and luscious, adheres partly to its long, pointed stone; shoots smooth; tree a slow grower, but productive. (See table.)

COLUMBIA.—(New York.) Very large, nearly globular, one side slightly larger; brownish purple, reddish brown where much shaded, with many fawn-colored dots; bloom blue, copious; stalk one inch, rather stout; cavity small; flesh orange, very rich and sweet, free from the stone, which is very small and compressed. Shoots downy, stout, blunt, spreading; leaves nearly round. (See table.)

PURPLE FAVORITE.—(New York.) Large, round obovate, no suture; brownish purple, thin light blue bloom. Approved in Santa Cruz County.

RED DIAPER.—(French.) Large, obovate, somewhat necked; reddish purple with few yellowish specks; bloom light blue. Approved in Sutter and San Benito Counties.

PRINCE ENGELBERT.—(Belgium.) Large, oblong oval, deep bluish purple, with dense bloom; stalk rather slender, with a fleshy ring at base; cavity rather deep and narrow; flesh juicy, melting, sweet; free stone; shoots downy. Approved in Alameda, Placer and El Dorado Counties.

RED MAGNUM BONUM; syn. *Red Egg.*—Large, oval, tapering to the stalk; suture strong, one side swollen; deep red in the sun; slight bloom; stalk one inch, slender, cavity narrow; flesh greenish, coarse, subacid; shoots smooth. (See table.)

PRINCE OF WALES.—(English.) Large, round, slightly oblong; reddish purple, with thick bloom; flesh greenish yellow, sweet, sprightly, adheres to the stone. Approved in Santa Barbara County.

IMPERIAL GAGE.—(New York.) Medium size, oval, suture distinct; stalk three-fourths inch, slightly hairy, evenly sunk; green, slightly tinged with yellow, with marbled green stripes; bloom copious and white; flesh greenish, juicy, melting, rich, and delicious, usually free from the oval, pointed stone; tree very vigorous and productive; shoots long, upright, slightly downy; leaves with slight shade of blue. A popular canning variety. (See table.)

GENERAL HAND.—(Pennsylvania.) Very large, roundish oval; skin deep golden yellow; stalk long; flesh moderately juicy, but lacks quality; freestone; shoots nearly smooth. Approved in Contra Costa, Yolo, Yuba, and El Dorado Counties.

DAMSON.—(English.) Small, roundish oval; purple, with thick blue bloom; melting, juicy, subacid. (See table.)

GERMAN PRUNE.—Common Quetsche. (Germany.) "This name has been applied in this State to numerous plums and prunes which are sold under it. The fruit of the true German prune is long oval, and swollen on one side; skin purple, with thick blue bloom; flesh firm, green, sweet, with a peculiar pleasant flavor, separates readily from the stone."—John Rock. Complaint is made in many localities of the tendency of the variety to drop before ripening, almost the whole crop sometimes dropping. The late John Lewelling claimed that an irrigation just before the tendency begins will hold the fruit. Others have claimed that thorough cultivation would hold the fruit. Apparently the trouble is dependent upon moisture conditions, to a certain extent, at least. (See table.)

KELSEY JAPAN.—Trees brought from Japan by the late Mr. Hough, of Vacaville, in 1870, and purchased by the late John Kelsey, of Berkeley, who propagated and fruited them for several years. First wide distribution was made by W. P. Hammon & Co., in 1884, who named the fruit after Mr. Kelsey. The following description is by H. E. Vandeman, U. S. Pomologist, from California and Florida specimens: "Tree upright in growth, leaves narrow, twigs brownish gray, resembling those of *Prunus chicasa* more than those of *P. domestica;* very productive, and apt to break down. Fruit from one and a half to two and a half inches diameter, heart-shaped, with a distinct suture on one side from stem to apex; stem is short, and set in a depression at the larger end; colors mixed yellow and purple, which vary in depth, but rarely make a brilliant appearance, covered with a bloom; flesh yellow, very firm, and clings to the stone, which is rather small, and nearly always partly surrounded by a cavity; when fully ripe the quality is very good." In California the tree resists drought remarkably; it is almost an evergreen, liable to injury in severe climates, but in the writer's garden at Berkeley it restarted its growth very soon after a temperature of 25° Fahr. had killed its leaves and most tender terminal shoots. Is likely to prove a profitable market and shipping variety. (See table.)

QUACKENBOS.—(New York.) Large, oblong oval; deep purple; suture faint; stalk short, slightly sunk; slightly coarse, sprightly, sweet and subacid, partly freestone. (See table.)

VICTORIA.—(English.) Large, obovate, suture distinct; color a fine light reddish purple; stem half inch, cavity rather deep and narrow; flesh yellow, pleasant, clingstone; next to Pond's Seedling in size, beauty, and productiveness. Approved in Mendocino, Contra Costa, Alameda, Kern, and Fresno Counties.

HUNGARIAN PRUNE; syns. *English Pond's Seedling: Grosse Prune d'Agen.*—(English.) This variety was brought to San Jose probably about 1856, and in some unaccountable way was first contrasted with the French prune and called the "great prune of Agen;" afterwards, also in a mysterious way, it took the name "Hungarian prune." It is still marketed by these names both here and at the East. The true name is English Pond's Seedling. Fruit very large, ovate, slightly tapering to stalk; skin thick, reddish violet, with numerous brown dots, and covered with handsome bloom; rather coarse, juicy, sweet; a very showy fruit; tree a strong grower and prolific bearer; fruit has a tendency to double; sells well in local and distant markets on its style. (See table.)

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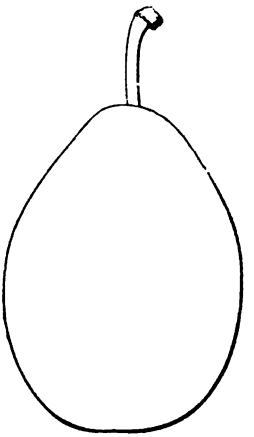

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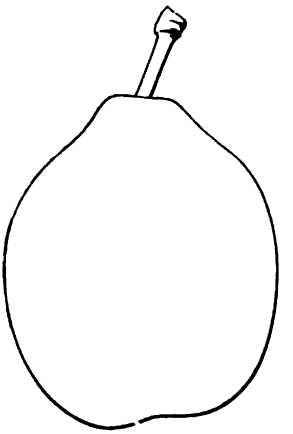

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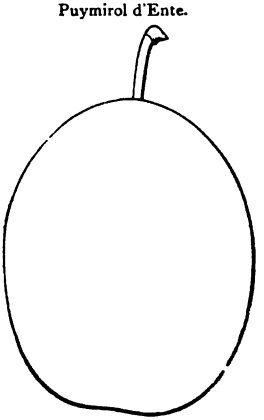
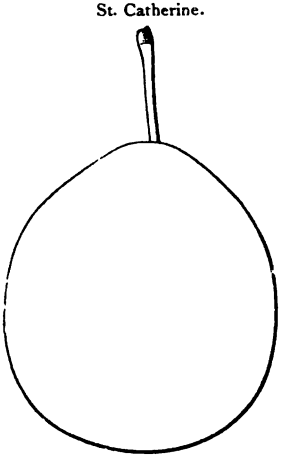


St. Catherine.



FRENCH PRUNES, CALIFORNIA-GROWN, BY FELIX GILLET.

Lot d'Ente, or d'Ente.—The type of the Prune d'Ente, the most propagated in the valley of the Lot. It is altogether propagated by the rooting of sprouts growing at the foot of old and large trees themselves true from the root—that is, not grafted. The fruit is not uniformly pyriform, like that of the Mont Barbat, some of the trees bearing fruit of a more oval shape, as shown in the engraving.

Mont Barbat d'Ente—From the orchard of that name, which means Barbat Hill, a type that obtained thirty-two first premiums for the beauty and size of its prunes, at the district fairs of the Lot, in France.

Puymirol d'Ente—This is another type of the d'Ente, but differing much in its botanical character from the d'Ente proper; it originated at Puymirol, in the southwest of France. The fruit is uniformly large and of a fine shape; it is somewhat more early than the d'Ente, very sweet, and dries well; it makes a first quality prune. The tree is productive, the fruit growing around the limbs much like the Green Gages and St. Catherine, close together.

Saint Catherine.—Fruit is of medium size, obovate or roundish oval, with a rather well-marked suture on one side; skin just thick enough to allow the fruit to dry splendidly; of a golden pale yellow, overspread with a thin bloom, and sometimes becoming rose violet on the sunny side. The flesh is yellow, firm and juicy, adhering but little to the stone (here in California we find it a perfect freestone); the flavor is very rich, perfumed; one of the best prunes to eat fresh. A vigorous grower and constant bearer; fruit stands shipping well; dried it retains the most of its bulk, and turns very dark.

PRUNE D'AGEN; syns. *Petite prune d'Agen; "French Prune,"* etc.—This is the drying prune at present most widely grown in this State. It is described by John Rock as follows: "Medium-sized, egg-shaped, violet purple, very sweet, rich and sugary; very prolific bearer." The first trees of the kind were grown by Louis Pellier, at San Jose, about the year 1857, the graft having been brought from France by his brother in December, 1856. The identity of this variety (which was first largely grown in the neighborhood of San Jose), with the variety chiefly grown in the French district tributary to Agen, was first announced by W. B. West, of Stockton, in the year 1878, during his visit to France. Since that time there has been much discussion of the matter, and Mr. Felix Gillet, of Nevada City, has been to great pains to send samples of our fruit for examination by fruit experts. The conclusion at which Mr. Gillet arrives, as stated in his catalogue of 1888–89, is as follows: "Our Petite prune is a true type of the d'Ente, its botanical characters being identical, and the fruit as richly flavored and sweet as that of its French ancestor. There is no such thing as a 'Grosse' or 'Petite' prune d'Ente or d'Agen, and such names have been used, and wrongly so, in this State. We finally succeeded in narrowing down this prune question to a simple question of 'size,' the fruit of the d'Ente in France attaining a much larger size than that of the California d'Ente, or Petite prune. But last summer's experience (1888) has demonstrated to us beyond a doubt that we were able to grow in California as large and fine prunes as are grown in the valley of the Lot, in France, if planting the same sorts and taking care of them and pruning them in the very same manner. Undoubtedly the soil and climate have much to do regarding the size and quality of prunes, and it cannot be reasonably expected that in certain sections of our State as sweet and large prunes can be grown as in other sections more favorably adapted to that class of fruit. We exhibited at the meeting of the State Horticultural Society at San Francisco, on August 31, 1888, the largest d'Ente or French prunes, and also St. Catherine prunes, grown on our *imported* stock, that were ever grown in this State, some d'Ente prunes weighing as much as one and three-fourths ounces."

Many prominent prune growers of California hold that the variety now chiefly grown in California is the true French prune, as declared by Mr. West, and attribute its variation in size, etc., to location, for it has been found that it is affected in a marked degree by local conditions. Mr. Gillet dissents from this conclusion, and contends "that there are several distinct types of that prune, which differ greatly from each other, the botanical characters of each of these varieties being far from identical." Acting on this belief, Mr. Gillet has imported and fruited other varieties which he considers superior to the prevailing California variety, and they are now being tried by other prune growers. The writer is indebted to Mr. Gillet for the descriptions and engravings on the preceding page.

ROBE DE SERGENT.—Though this term is given in Downing as a synonym of Prune d'Agen, and seems also to be in France a synonym for the d'Ente prunes, there is now being grown in this State from an importation by John Rock, of San Jose, another prune quite distinct from the foregoing. W. B. West, of Stockton, also imported a variety under this name, and describes it as distinct from the common French prune of this State, and superior to it. Mr. Rock describes the variety as follows: "Fruit medium size, oval; skin deep purple, approaching black, and covered with a thick blue bloom; flesh greenish yellow, sweet, and well flavored, sugary, rich and delicious, slightly adhering to the stone." This variety makes a larger, darker-colored dried prune than the prune d'Agen, and has sold in some cases at a higher price. It should have a distinctive name to avoid confusing it with the commonly-grown French prune, of which Robe de Sergent is a synonym, as stated. Mr. Gillet proposes to call it "Loire d'Ente" or "Loire Robe de Sergent," as he has traced its origin to the Loire Valley, in France.

BURGUNDY PRUNE; *Prune d'Agen* (?).—Medium ovate, necked, reddish black; juicy, rich, pleasant; freestone. Approved in Santa Cruz and Los Angeles Counties.

BULGARIAN.—"An undetermined variety grown under this name, chiefly in the vicinity of Haywards, Alameda County; above medium size, almost round, dark purple; sweet and rich, with pleasant acid flavor; tree a vigorous grower, and an early, regular, and profuse bearer."—John Rock. Local comparisons with other prunes, as follows: "As prolific a bearer as the Petite prune, but holds its size with a heavy load of fruit much better. The tree is a more vigorous grower and forms a larger tree and

bears its fruit more in the center of the tree. Closely resembles the Fellenberg or Italian prune in form and size, but is not quite so large. It is rich and sweet when cured. It is not a freestone, but on some soils and in some seasons it has a tendency to loosen from the pit."—W. H. Jessup. "The Fellenberg and the Bulgarian make a black prune, and have a rich, pleasant, subacid flavor, when cured, and require only a little sugar when cooked and prepared for the table."—W. C. Blackwood. Approved in Sonoma, Alameda, Los Angeles, and Merced Counties.

COE'S GOLDEN DROP.—(English.) Very large, oval, suture distinct, one side more enlarged, necked; light yellow, often dotted red to the sun; stalk three-fourths inch, rather stiff; flesh yellowish, firm, juicy, and rich, closely adhering to the pointed stone; shoots smooth, rather glossy. A standard late variety for canning.

BAVAY'S GREEN GAGE; syn. *Reine Claude de Bavay.*—(French.) Large, round oval, greenish yellow, spotted with red, with small violet-colored longitudinal veins; flesh rather firm, juicy, sugary, rich, of fine quality, adhering slightly to the stone; shoots smooth, leaves roundish, shining; a free grower and very productive. Approved in Contra Costa, Alameda, Butte, Placer, and Amador Counties.

ICKWORTH IMPERATRICE.—(English.) Large to medium, obovate, purple, with irregular streaks of fawn color; stalk medium; flesh greenish yellow, sweet, juicy, rich, mostly adhering to the rather small stone; shoots smooth; very late, hangs long on the tree, and keeping well; endures long shipment well. Approved in Santa Clara, Santa Cruz, Butte, and Placer Counties.

FELLENBERG; syns. *Large German Prune, Swiss Prune, Italian Prune.*—Medium size, oval, pointed and tapering at both ends; suture small, distinct, dark purple, with dark blue bloom; stalk one inch, scarcely sunk; flesh greenish yellow, juicy, sweet, delicious, parts from the stone; tree a free grower and very productive; late, excellent for drying. But little grown in California, but largely in Oregon.

ST. MARTIN'S QUETSCHE.—(German.) Size medium, ovate, broadest at base; surface pale yellow, often spotted with brown; bloom white; flesh yellowish, very juicy, rich, excellent; ripens late and keeps long; tree hardy and a good bearer; shoots smooth. Approved in Santa Cruz County.

COE'S LATE RED; syn. *Red St. Martin.*—Size medium, roundish, suture distinct on one side; skin light purplish red, or dark red; bloom thin, blue; stalk three-fourths inch, scarcely sunk; flesh rather firm, crisp, rich, vinous; very late; shoots downy. Approved in Santa Clara, Santa Cruz, and Monterey Counties.

PACIFIC COAST VARIETIES.

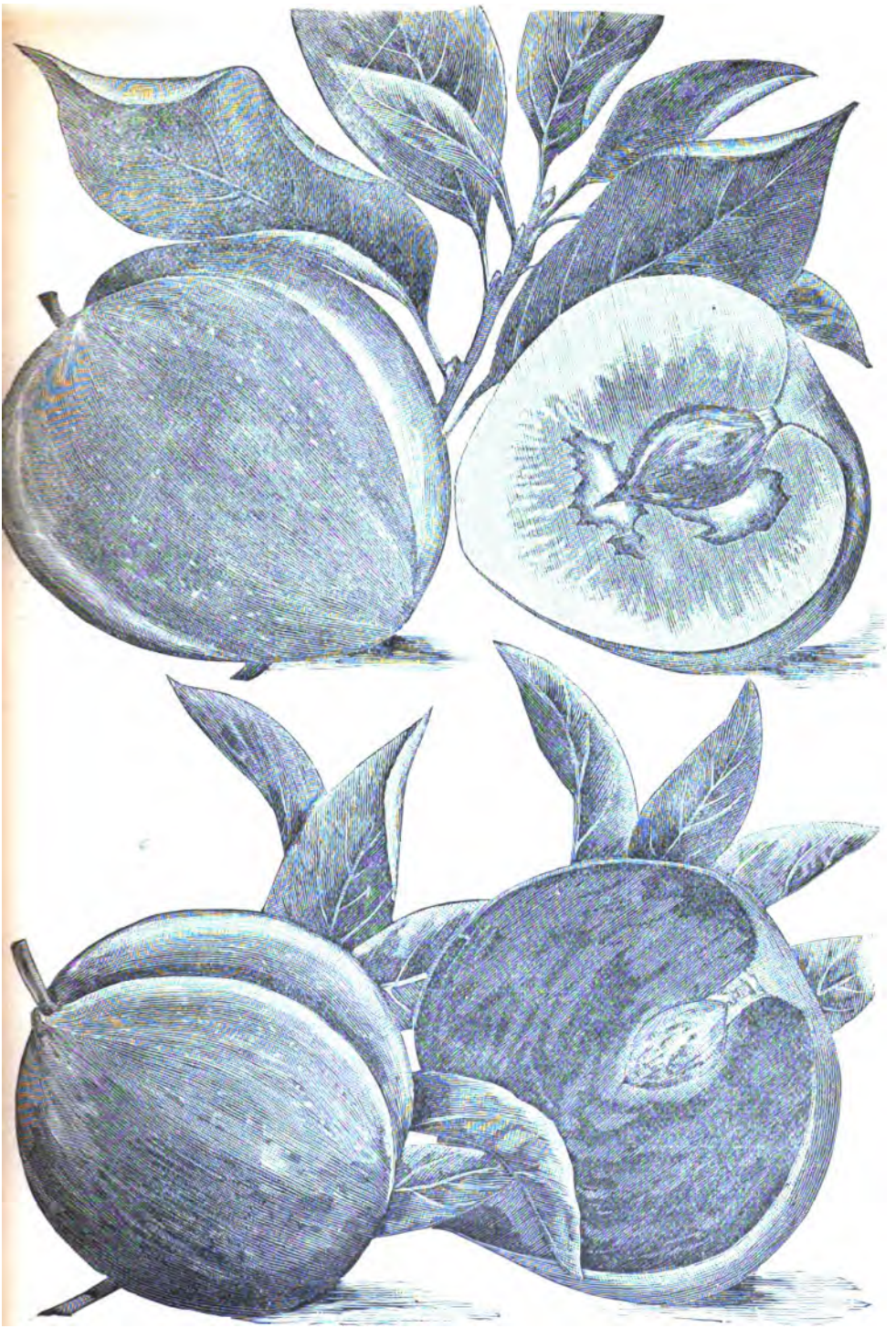
GRELCK.—An undetermined variety, supposed to be a seedling, of which a small tree was given about 1883 by the late John Grelck, of Los Angeles, to O. S. Chapin, of San Diego County, and afterwards propagated and distributed by Chapin & Meeker, of Poway. Of the cherry plum type, but a little earlier; about one inch in diameter, round, light yellow, shaded with red; flavor good; sprightly; tree thrifty and prolific. Clearly superior to common cherry plum in quality.

CLYMAN.—(California.) Originated many years ago from seed planted by Mrs. Clyman, in Napa Valley; propagated by Leonard Coates, of Napa; mottled reddish purple, with beautiful blue bloom; freestone; flesh firm, dry, and sweet; ripens with cherry plum, but superior. J. M. Bassford, of Vaca Valley, says it resembles an under-sized peach plum, but ripens fully two weeks earlier. Tree very prolific. The Clyman has commanded high prices for Eastern shipment.

TRAGEDY PRUNE.—(California.) Originated with Mr. Runyon, near Courtland, Sacramento County. Introduced by W. R. Strong & Co.; appears to be cross between German prune and Purple Duane; medium size, nearly as large as Duane, looks much like it, except that it is more elongated; skin dark purple; flesh yellowish green, very rich and sweet, parts readily from pit; ripens in June. "The first large plum to ripen; very fine, and valuable for Eastern shipment."—L. W. Buck.

SILVA'S KONING CLAUDIE; syn. *Miller's Early.*—An undetermined variety, brought from Germany by the late Dr. L. E. Miller, of Placer County, in 1854; first propagated for sale by C. M. Silva & Son, of Newcastle, in 1887. A richly-colored blue plum of fine flavor, about the size of Royal Hative, but about a month earlier. Approved in Placer County.

GLAISTER.—(California.) Introduced by Leonard Coates, of Napa; nearly as large as Yellow Egg, of same shape and color; two to three weeks earlier; a profit-



JAPANESE PLUMS—KELSEY AND SATSUMA.

able canning and shipping plum. Works well on peach root, which Yellow Egg does not.

SILVER PRUNE.—(Oregon.) Originated with W. H. Prettyman, who says: "It is a seedling from Coe's Golden Drop, which it much resembles, but it is much more productive; one tree of Silver prune produces more fruit than five of Coe's Golden Drop." "Samples of dried fruit brought the highest price in the San Francisco market, and it is, in the judgment of fruit experts, because of its large size and superior flavor, entitled to rank first among prunes and drying plums."—John Rock. Question of identity with Coe's Golden Drop is still in dispute between growers. Sells well as a market and shipping plum, and dries handsomely.

GOLDEN PRUNE.—Originated from seed of Italian prune by Seth Lewelling, of Milwaukie, Oregon, and described by him (in a letter to the writer, Nov. 27, 1887) as larger than Italian, light golden color, exquisite flavor, dries beautifully, and when dried twenty-four prunes weigh one pound; a beautiful grower, with heavy, dark green foliage, so heavy that the fruit is well protected; an abundant bearer, and one of the finest canning fruits known; easily peeled and separates readily from the stone, which is quite small for the size of the fruit.

CHAMPION PRUNE.—Originated by the late Jesse Bullock, of Oswego, Or., from the seed of the Italian prune. Named by the Oregon Horticultural Society. Ripens three or four weeks before the Italian; large and round, of a reddish purple bloom; flesh very firm, and of a sweet, vinous flavor, and parts from the stone freely; the tree is a good grower, and an abundant, early bearer.

BURBANK'S SEEDLINGS.—Luther Burbank, of Santa Rosa, exhibited at the meeting of the State Horticultural Society, August 31, 1888, seventy seedlings of the French prune of his own growing. They were of great variety in form, size, and color, from golden yellow to almost black; size from a pigeon's egg to a large hen's egg, and in form, from oblong to nearly round. He has also fruited fifteen seedlings of Hungarian prune (English Pond's Seedling), which also show a great variety of characteristics. Some of these will no doubt be found of great value.

RECENTLY-INTRODUCED JAPAN PLUMS.

KELSEY'S JAPAN.—See page 355.

BOTAN.—Dark yellowish red, with white bloom; sweet, rich, juicy, and delicious; tree vigorous, upright.

CHABOT.—Greenish purple, very large and firm; tree vigorous and a good bearer.

SATSUMA; syn. *Blood Plum of Satsuma.*—Introduced and first fruited in this country by Luther Burbank, of Santa Rosa. Described by Professor H. E. Van Deman, U. S. Pomologist, as follows: "Leaves more lanceolate than those of Kelsey; fruit averages about two and a quarter inches in diameter, nearly round, and but slightly sutured on one side; surface dark red, under a thick bloom; dots rather conspicuous and numerous; flesh dark purplish red, which has caused the name of 'Blood Plum of Satsuma' to be given by some; stone very small and pointed."

Specimens of Satsuma sent to the writer by Mr. Burbank in August, 1887, were described as follows: Almost globular, being six and three-fourths inches around horizontally and six and five-eighths inches around vertically; color is dark red, almost solid color, except a slightly lighter shade in the suture; bloom thin and of a lilac shade; flesh dark red, solid color from skin to pit, firm, rather juicy, and of good flavor; pit very small, three-fourths by half inch; ripens much earlier than the Kelsey.

BURBANK.—Tree imported from Japan by Luther Burbank, and found to differ in growth and fruit from other Japanese varieties. Named "Burbank" by Professor Van Deman. Tree usually vigorous, with strong, upright shoots, and large, rather broad leaves; comes into bearing very early. The fruit described by the writer from specimens sent by Mr. Burbank in August, 1887, as follows: Almost globular, being five and a half inches around horizontally and five and five-eighths inches around vertically; rich cherry red, slightly mottled with yellow and freely dotted with same tint; flesh deep yellow, juicy, very sweet, and of fine, somewhat peculiar, but very agreeable flavor; pit is very small, three-fourths by a trifle over half inch in diameter.

TABULAR STATEMENT OF ADAPTATIONS.

The table on the following page is prepared as already described in chapters on other fruits preceding.

TABLE EMBODYING REPORTS FROM ACTUAL GROWERS, NAMING VARIETIES OF THE PLUM CONSIDERED MOST SATISFACTORY IN THE COUNTIES INDICATED.

COUNTIES OF CALIFORNIA.	Cherry	Tragedy Prune	Peach	Royale Hative	Bradshaw	Green Gage	Duane's Purple	Washington	Yellow Egg	Jefferson	Columbia	Red Mag Bonum	Imperial Gage	Damson	German Prune	French Prune	Kelsey's Japan	Quackenbos	Hungarian	Coe's Gold	Silver Prune	Fellenberg
Del Norte																						
Humboldt																						
Mendocino																						
Lake																						
Napa																						
Sonoma																						
Marin																						
Contra Costa																						
Alameda																						
Santa Clara																						
San Mateo																						
Santa Cruz																						
San Benito																						
Monterey																						
San Luis Obispo																						
Santa Barbara																						
Ventura																						
Los Angeles																						
San Diego																						
San Bernardino																						
Kern																						
Tulare																						
Fresno																						
Merced																						
Stanislaus																						
San Joaquin																						
Sacramento																						
Solano																						
Yolo																						
Sutter																						
Yuba																						
Butte																						
Colusa																						
Tehama																						
Shasta																						
Trinity																						
Siskiyou																						
Modoc																						
Lassen																						
Plumas																						
Sierra																						
Nevada																						
Placer																						
El Dorado																						
Amador																						
Calaveras																						
Tuolumne																						
Mariposa																						
Alpine																						
Mono																						
Inyo																						

CHAPTER XXIII.

THE QUINCE.

THE quince enjoys California conditions to the utmost, and rewards the grower with large crops of very large and beautiful fruit. A quince weighing a pound is no curiosity, and it is unlikely that any city of the world can show such fine quinces at such low prices as San Francisco. The lesson from this fact is that the fineness of the fruit, and the evident adaptation of the State to its growth, should not alone be considered by the planter. The local consumption of quinces is naturally small, and it is chiefly for home preserving and jelly making. The commercial jelly makers use apple juice as the basis of nearly all their jellies, only using a little quince for flavoring, and some housewives follow the same course. The hope for profitable sale of the fruit in large quantities must therefore rest on distant markets, and though those well acquainted with the growth and sale of the fruit in the cities of the Mississippi Valley, have predicted a great demand for the California quince in that territory, experiences of shippers thus far have been varied, and not such as to induce the extension of our quince production, at present at least.

Robert Howe, of Sonoma Valley, is the largest quince grower in California. He has twenty acres, planted with three thousand two hundred trees of the apple and orange varieties. The orchard is now ten years old. Considerable fruit was produced sooner, but in 1885, when the trees were in their seventh year, they bore their first full crop, which amounted to about two thousand four hundred boxes. Later crops have been, of course, heavier, and Mr. Howe writes me that his trees, trained as standards, are about as large as his peach trees of the same age. He finds his quinces about as profitable as apples, but he wisely adds, "They would not be if they were as plenty as apples." He ships about three-fourths of his crop to Eastern markets, the balance to San Francisco.

But though the quince in California has at present narrow commercial limitations, a few trees should find a place in every orchard, for family use or for local sale.

CULTURE OF THE QUINCE.

The quince is readily grown from cuttings. Take good-sized shoots of well-matured wood of the current year's growth, after the leaves drop in the fall, and set out at once in nursery row in moist, alluvial soil, or in any loose soil which is well drained and can be kept moist enough by cultivation or irrigation. Mr. Howe put out his cuttings in a low, sandy place in Sonoma Creek, and the winter's high water seemed to help them, for he secured a fine lot of trees by the first year's growth of the cutting.

Quinces are planted at all distances apart, and are grown either as bushes or trees. Undoubtedly the best way is to plant about fourteen or sixteen feet apart, and prune into low standard tree form. This can be done much as already advised for other fruit trees. An annual cutting back of about half of the new growth, while forming the tree, will strengthen the trunk and limbs and prevent the running out of long leaders, which droop to the ground on all sides when laden with fruit, and are often broken by the weight and the wind. Owing to the disposition of the quince to throw out several small shoots at a single point, it is advisable, when forming the tree, to remove all buds but one, just as the growth is starting. This will give one good, strong branch where it may be needed, instead of several weak ones. Pinching of shoots which start out too vigorously, or at undesirable points, is, of course, advisable.

SOILS FOR THE QUINCE.—As the quince grows naturally in moist, though not wet, lands, many persons think it always does best in springy ground or along the banks of rivulets; but though moist soils are preferable to dry, such positions are not essential to obtaining large crops of fine fruit. In fact, the quince, like most fruit trees, prefers a well-drained location, and does best on a soil which can be freely worked. It thrives when fanned by the ocean breeze and does fairly well in the interior, providing it has moisture enough in the soil, and in some situations will doubtless require summer irrigation.

VARIETIES OF THE QUINCE.

Though probably all varieties of the quince are introduced by our nurserymen and carried by them in small stock, most plantations are of the "apple" or "orange" variety. The following may be enumerated, however, as growing in this State:—

APPLE OR ORANGE.—Large; bright yellow; the best. August and September.

ANGERS.—Large; yellow; a strong-growing sort, and abundant bearer; October and November.

PORTUGAL.—Very large, and fine flavor, turns a fine purple or deep crimson when cooked.

REA'S MAMMOTH.—A very large and fine variety of the Orange quince; a strong grower and very productive.

CHAMPION.—Fruit very large, fair and handsome; tree very productive, surpassing any other variety in this respect; bears abundantly when young; flesh cooks as tender as an apple, and without hard spots or cores; flavor delicate, imparting an exquisite quince taste and odor to any fruit with which it is cooked.

THE CHINESE QUINCE.—A most extraordinary fruit, oblong, of immense size, often weighing from two to two and one-half pounds; growth rapid and distinct.

MEECH'S PROLIFIC.—First described as the "pear-shaped Orange quince." Obscure pyriform, very large; bright golden yellow, fragrant and of high flavor. Named for W. W. Meech, author of a book on Quince Culture, published in 1888, by Orange Judd Co., of New York

WEST'S MAMMOTH.—Originated by W. B. West, of Stockton, from seed received from Boston in 1853; of the Orange quince family; round; clear yellow; very large; fine flavor and for the class a very good keeper. "It was so large and had so many fine points that in my nursery business I propagated no other. It has been distributed over the State, and in our county no other is used."—W. B. West.

PART FOURTH: THE GRAPE.

CHAPTER XXIV.

RISE AND PROGRESS OF THE GRAPE INTEREST.

THE culture of the grape is one of the great divisions of California horticulture, and constitutes an industry of great accomplishment and still greater promise. Its three chief divisions are: Grapes for the table, grapes for wine, and grapes for raisins. In all these branches, the product has far exceeded local requirements and has become an important item in the export trade of the State, and yet, considering the special adaptation of California conditions to grape culture and the importance of grape products in the world's commerce, it is confidently believed that the vine industry of the State is but in its infancy.

Though the grape was one of the earliest of the fruits introduced upon California soil, as has already been shown in the chapter relating to the fruits of the old Missions, it is but recently that grape products have reached large amounts, and the producers are still confronted with problems in the growth of the vine and in the manufacture and marketing of its products which will require the fullest devotion, the keenest intelligence, and .the brightest spirit of enterprise, to bring to satisfactory solution. For this reason the industry is progressive and fit to awaken patience, perseverance, energy, and acumen among those who intelligently pursue it.

Not only was the grape the first fruit in the esteem of the old Mission Fathers, but its culture has always been a favorite enterprise since the American occupation. As early as 1855 large collections of the best European varieties were brought into the State, a leader in this work being Mr. A. Delmas, of San Jose, who secured cuttings in France, which, being packed in boxes, successfully withstood a six months' journey around the Horn. In 1858 Mr. Delmas had one hundred and five European varieties growing, and many of them in bearing.

The opportunity for California in the grape industry was foreseen very early, and with such clearness that State aid toward its realization was successfully invoked for it first of all industries.

In 1861 Governor Downey appointed three commissioners "to report upon the best means and ways to promote the improvement and culture of the grape-vine in California. The late Agoston Haraszthy, who was one of the members of this commission, visited the principal viticultural regions of Europe, returning with much valuable information and two hundred thousand cuttings and rooted vines of every variety found in Europe, Asia Minor, Persia, and Egypt. Vine planting and grape production increased, until, in 1870, the supply of table and wine grapes was greater than the demand, and several years of depression followed. In 1880 there was a sharp revival. The State Viticultural Commission was established, under the leadership of Charles A. Wetmore and Arpad Haraszthy. Provided for by the same act which established the Viticultural Commission, and beginning with it in practical accomplishment in the year 1880, was the work under direction of Professor Hilgard, in the Viticultural Laboratory of the State University at Berkeley, and this work has been of incalculable value in furnishing a scientific basis upon which the selection of grape varieties, the determination of resistant stocks, and the manufacture of wines and similar important matters, have proceeded. Instruction in viticulture and viniculture has accompanied investigation, and the work has proved so popular and satisfactory that increased facilities have been provided from year to year, until at present the laboratories and experimental cellars at Berkeley are as well equipped as any in the world, and the six outlying culture stations in the different parts of the State afford means for testing the growth of grape varieties, which properly complements the investigation of the products derived from them in the laboratories and cellars of the central station in Berkeley.

Recently, too, the State Viticultural Commission has greatly enlarged and improved its working facilities at its offices at 317 Pine Street, San Francisco, and introduced features for the exhibition of grape products and for promoting traffic therein which promise much for the profitable extension and commercial stability of the industry.

Following the inception of viticultural work by State aid in 1880, the vineyard area of the State was notably extended; introduction of the best foreign varieties for different purposes was a common enterprise; the use of resistant roots to check the destruction by phylloxera was undertaken in regions to which the insect had gained access. The production of wine increased until difficulties were encountered in marketing, about 1887, which prevailed during the few years following, but now (1891) there is a prospect of better prices for the wine product,

which, because of somewhat reduced acreage, is not expected to increase unless the improvement should be marked enough to stimulate increased planting of wine grapes. The production of table grapes for Eastern shipment, and especially of varieties suitable for raisins, has increased notably during the last few years. The extension of the raisin vineyard area has been great and is still advancing.

EXTENT OF THE VINE INTEREST AND ITS PRODUCTS.

Pertinent to the subject is a statement of the extent of the grape products of California for a series of years, as follows:—

	RAISINS (20-lb. boxes.)	WINE (gallons.)
1873	6,000	
1874	9,000	
1875	11,000	
1876	19,000	
1877	32,000	4,000,000
1878	48,000	5,000,000
1879	65,000	7,000,000
1880	75,000	10,200,000
1881	90,000	8,000,000
1882	115,000	9,000,000
1883	140,000	8,500,000
1884	175,000	10,000,000
1885	500,000	11,000,000
1886	703,000	18,000,000
1887	800,000	15,000,000
1888	915 000	17,000,000
1889	1,237,500	15,000,000
1890	2,200,000	15.000,000

The production of brandy was over one million gallons in 1890. The raisin product does not include about eight million pounds of dried grapes which were produced in 1890 and sold at higher prices than ever before. It is estimated that the acreage of California vineyards in 1891 comprises 225,000 acres.

A notable feature of our advancement in grape culture and grape products is the creation of quite an extensive local literature on the subject. The publications of the State Viticultural Commissioners and of the Experiment Station of the State University should be sought by all vine planters. There have also appeared several private publications on the grape, which the grower will find valuable. Because of these available supplies of California literature of the grape and its products,* the writer

*The grape literature of California includes the following:—

"Grape Culture, Wines and Wine Making," by A. Haraszthy: Harper Bros., N. Y., 8vo, 420 pp., 1862.

"Hand-book of Grape Culture," by T. Hart Hyatt: A. L. Bancroft & Co., S. F., 12mo. 315 pp., second edition, 1876. (Out of print.)

"The Wine Press and the Cellar," by E. H. Rixford: Payot, Upham & Co., S. F., 8vo, 240 pp., 1883. (Continued on next page.)

of this treatise proposes to restrict his treatment of the subject to certain plain details of culture, which it is hoped will be sufficient to enable the reader to proceed with the growth of a vineyard, but he is urged to provide himself, as far as possible, with the general literature on the subject, because the limits of this work preclude allusion to many themes of special character and value.

THE GRAPE AREA OF CALIFORNIA.

The grape has a very wide range in California. If the immediate sea coast and the higher altitudes on the mountains be excepted, the grape may be planted with a good chance of success anywhere if soil and local topography be suitable. As has been shown in Chapter I, the vine can approach quite close to the ocean if some shelter from prevailing cool winds be afforded, and quite high on the mountains if one keeps out of depressions where late frosts are frequent. In planting the grape in doubtful situations much depends upon choice of proper varieties. For example, in the cool air of the coast region, early maturing varieties must be the main reliance, for late sorts will not receive heat enough to bring them to full maturity.

Away from immediate coast influences, and up to perhaps three thousand feet or more on the sides of the Sierra, the grape is successfully grown both upon the floors of the valleys and upon the hillsides. But there is still need of choice both of special locations and of varieties according to the purposes which the grower has in view. The coast valleys of the upper part of the State produce good table grapes, but they are unfavorable for the raisin industry because of the deficient sunshine and excessive atmospheric humidity of the autumn months. The best raisins are made in the dry, heated valleys of the interior, and the conditions which there develop the fullest quality in the raisin grape also develop the sugar in some kinds of wine grapes beyond a desirable percentage. Here again the choice of suitable varieties intrudes itself, for the varieties which yield light table wines in the coast valleys may yield heavy "heady" wines in the interior. Valleys, too, as a rule, although they yield larger crops of grapes and greater measure of wine than similar area on the hillsides, must yield the palm for quality to the warm soils of the slopes. And here enters the business proposition whether large amount and less quality is better than less amount and higher

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"Grape Culture and Wine Making in California," by George Husmann: Payot, Upham & Co., S. F., 12mo, 380 pp., 1888.

"Repor s of State Board of Viticultural Commissioners," and numerous appendices thereto, 1881 to 1890: published by the State.

"Reports of Viticultural Work at the University of California," and numerous bulletins, 1881 to 1890: published by the State.

quality. To this there can be no general answer. It depends upon the disposition which is to be made of the crop, and the demand for it.

These few facts out of many which could be stated will serve to enforce the fact that wide as is the range of the grape, both localities and varieties for certain purposes must be intelligently chosen. Much has been learned during the last few years, but it will require the experience of another generation, perhaps, to make the matter clear.

SOILS FOR THE GRAPE.—The grape will thrive on a great variety of soils, in fact, on any of those enumerated as fruit soils in Chapter III. There are thrifty vineyards on the light, deep valley loams, on the heavy clayey loams, on adobe, and on the red soils of the foot-hills. Even on shallow soils the grape will do well if given sufficient moisture, and on rocky subsoils it thrives if there be crevices for the roots to penetrate, or if the rock be shattered to admit the roots to permeable substrata, as described on page 139. Standing water during the active period of the vine is, however, unfavorable to growth, and the touch of alkali is fatal to any satisfactory results of wine making. Almost any soil which does not hold excess of water or is not tainted with alkali will do for the vine, although the plant appreciates good, deep soil, and will grow and bear fruit in proportion to its supply of it. Of course the economic question of ease of cultivation enters into the choice of soil for the grape, as for other fruits, but its claims are obvious and need not be enlarged upon.

LENGTH OF THE GRAPE SEASON.—By choice of early and late varieties the grape season extends over a half year in California, without recourse to artificial means of preservation. Where the fall rains are not very protracted, the late varieties keep in good condion on the vines until the winter pruning. Good grapes have been picked from the vines as late as the middle of January.

CHAPTER XXV.

PROPAGATING AND PLANTING VINES.

THE grape is propagated from seed or by layers, or by cuttings of various lengths. Growing from seed is only resorted to in California to get stocks for resisting the phylloxera, and even in securing such stocks, cuttings are more generally used than seedlings. There is at present no disposition to grow grape seedlings in the hope of securing better and hardier varieties, as is so largely done in other parts of the country. The vast numbers of varieties of the European species, *vinifera*, which we have to draw from, makes the effort for new seedlings of little object.

GROWING VINES FROM SEED.—Seed is easily removed from wild grapes by crushing the berries and stirring the pulp rapidly in water. The wild fruit may be gathered from the vines which are found along streams in most parts of the State, but it is desirable to gather from vines which are far removed from any cultivated vines, to escape danger of hybridization. Mr. C. Mottier, of Harbins Springs, Lake County, who has made a specialty of seed of the *Vitis Californica* for a number of years, insists strongly on this point. Professor Husmann says that one pound of good, fresh seed will give from two to three thousand seedlings.

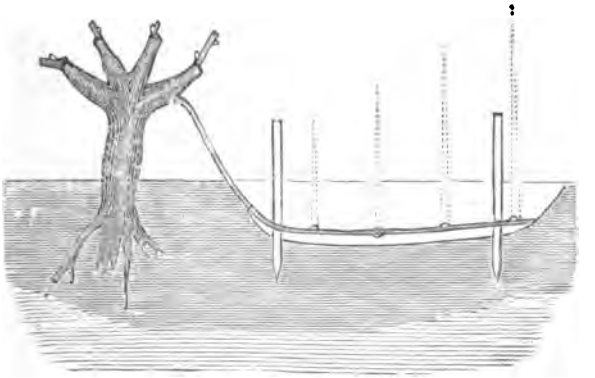
Some advocate sowing grape seed in the fall, just as it is taken from the fruit, but best results are usually obtained by spring sowing. Nor is it advisable to sow too early, for fear of frost on the young plants. In the University experiments at Berkeley, the best results have been attained by sowing grape seed the last of March or first of April. Professor Husmann advises sowing in February or March, delaying the sowing in frosty situations.

It is advisable to keep grape seed moist for some time before sowing. Mr. Klee's practice at the University gave quickest germination with seed soaked one week in water, and afterward allowed to lie in a heap for three weeks. The greater part of such seed started in ten days or two weeks after being put in the ground. Professor Husmann advises pouring hot water on the seed and allowing it to cool, the seed remaining in the water for twelve hours, and after that it is kept for a week in

a sack, exposed to the sun, and covered at night, the sack being moistened from time to time.

The seed should be sown in the open ground, the soil having been worked deeply and finely, as for a garden. Sow the seeds about an inch apart, in drills far enough from each other to admit of the use of the cultivator in the summer; cover not to exceed an inch in depth, and after moderate pressing of the ground cover the whole bed with rotten straw, which should be gradually removed as the sprouts appear above the ground. This mulch will not only retain moisture, but will prevent the surface from being crusted by heavy showers. Summer cultivation with cultivator and hoe should be given. In good soil in a favorable situation a considerable portion of the seedlings will reach grafting size during the first summer's growth. Their subsequent treatment will be considered in connection with grafting the vine.

GROWING VINES BY LAYERING.—This is another mehod of multiplying vines which is but little employed in California,

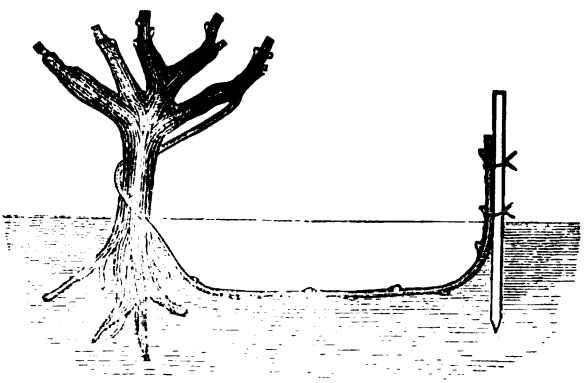


LAYERING TO MULTIPLY VINES.

because it is so much easier to secure plants by cuttings, as the *vinifera* species roots so readily. Layering consists in bending down and burying a cane so as to facilitate top and root growth from each of the buds. The engraving shows an old vine stump, one of the lower canes of which has been layered, and from which shoots are expected, as shown by the dotted lines. To hold the cane in place, stakes are used. The engraving shows the cane as just ready to start into growth, the filling of the trench being deferred until the lateral shoots grow out considerably, and then, by covering, the roots are developed. The cane must rest in moist earth, and usually has to be watered artificially, as well as treated to prevent evaporation. The following winter the cane is raised and a plant made at each node.

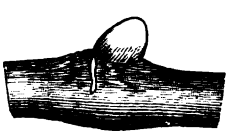
Another use for layering is to fill a vacancy in the row, a cane being taken from the nearest living vine, as shown in the engraving. In this case the layer must be set in a deep trench so as not to be torn out by the plow, and the layered cane is at once covered in with earth, all but one or two buds at the extremity, where the new vine is desired. In the engraving the cane is given a twist around the old stump so that it may enter the ground where it will not be caught by the cultivator. Such a layer usually bears the second year and is then detached from the parent vine.

Both the layers described are laid down early in the spring, before growth starts in the vine. Summer layers of the current season's growth are sometimes made, but are not usually satisfactory.



LAYERING TO FILL A VACANCY.

GROWING VINES FROM CUTTINGS.—This is the prevailing method in this State both to secure grafting stocks and to grow vines on their own roots. In growing from cuttings, different policies are adopted, *i. e.*, placing the cuttings in permanent place in the vineyard, or rooting them in nursery to be afterward transferred to the vineyard as "rooted vines." First, the various kinds of cuttings will be considered, and their placing mentioned later.



CUTTING WITH SINGLE EYE.

GROWTH FROM SINGLE EYES.—The use of single eyes or single buds, the shortest possible form of cutting, is not large in California, but some growers have reported good results. The method is to prepare the cuttings as shown in the engraving, and plant them carefully, with the bud upwards, in well-prepared soil, covering the cutting completely, but very little under the surface. Success depends upon retention of moisture in the surface soil

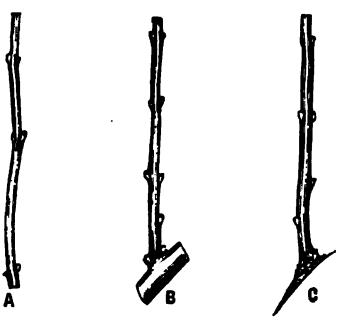
to induce rooting, and mulching is advisable. The method of propagation, too, seems best adapted to the moister parts of the State, whence, in fact, most success with it has been reported.

GROWTH FROM SINGLE EYE.

Besides economy of wood in getting a plant from each bud of the cane, which is sometimes an object, growing from single eyes is advocated because of the satisfactory root system secured, which, as the engraving shows, much resembles that of a seedling. The use of single eyes is obviously better adapted to nursery than to field growth.

THE USE OF LONGER CUTTINGS.—There are several kinds of cuttings generally recognized by vine growers, of which two may be specified, as follows: The ordinary cutting consisting wholly of the wood of the previous season's growth and a cutting which retains more or less of the older growth. Where the cutting retains a small cross-section of an older cane, it is termed a "mallet cutting," from its obvious resemblance thereto, as shown at *B* in the engraving. Some hold that this round piece of old wood is undesirable because it is apt to decay, and they restrict the old wood to the top fragment, which carries the dormant buds at the base of the cane. Such a cutting is shown at *C* in engraving.

Though the use of the old wood is correct enough in theory and satisfactory in practice, it is the ordinary cutting, shown at *A* in the engraving, which is relied upon in vine propagation. There is, however, wide difference in opinion and practice as to how long this cutting should be to secure the best results. Ordinary cuttings, as used in California, vary in length from ten inches to three feet. Clearly enough this disagreement is due in part, at least, to different local conditions under which the vine is to make its growth, but two things are generally accepted as the result of California practice, and this is, perhaps, only confirmatory of experience abroad: *First*, that the tendency is toward the use of shorter cuttings than formerly; *second*, that where the longer are used, they should be set obliquely, so as not to bury the lower extremities too deeply in the ground. What distance *is*



DIFFERENT FORMS OF CUTTINGS.

too deep depends, to a great degree, upon the soil and locality, for a cutting will grow good roots at a much lower level in the light, warm loams of the interior valleys than in any other soil or situation, and longer cuttings are used in the interior than in the coast regions. Experience of successful vine growers in different districts may be usually had for the asking by the newcomer, and is the safest rule of practice. If local opinions differ somewhat, the inquirer must adjudicate the matter to the best of his ability. The usual length of cuttings is from eighteen to twenty inches.

MAKING AND CARING FOR CUTTINGS.—Cuttings can be taken from the vines at any time after the fall of the leaf and before the spring flow of sap begins. The earlier cuttings—those taken before January—are more likely to make a successful start and after-growth than those cut later in the season.

It is common, however, to defer preparation of cuttings till the pruning is done, be it early or late, and this will generally answer the purpose, if care be taken to secure the cuttings immediately at the pruning; but if the branches be allowed to lie upon the ground for days, exposed to sun, wind, or frost, before the cuttings are secured, their chances of growth are seriously lessened, and a goodpart of the failures in planting are due to such cuttings.

Cuttings should be taken from short-jointed, well-ripened wood of the previous year's growth, cut squarely and smoothly just below a bud. Cuttings from the middle or top end of branches are not so likely to root, nor to grow so vigorously, as those from the butts or ends nearest the old wood.

Keep them dormant until the time comes to set them in the vineyard, else the tender shoots may get broken. To keep them back, place them, at the pruning, in shallow trenches, top down, on the north side of a close board fence or a building, cover the butts with loose earth, and over that throw some straw and boards. Take care that the trenches are in moist but not wet ground, as too much moisture rots the cuttings. If the ground should not be moist enough, or if the cuttings seem dry or withered, plunge them in water to within three or four inches of their top, for a few days before setting, and do not let them dry again before planting.

ROOTING CUTTINGS IN NURSERY.—What has been written is in reference to cuttings designed for placing in permanent position in the vineyard, but, for the most part, applies as well to the preparation of cuttings for the nursery. For nursery treatment, however, shorter cuttings can be used than for field

planting, because of the better cultivation and more generous moisture conditions which are usually provided.

In preparation of ground for the rooting of vines and the planting of cuttings therein, the suggestions in Chapter VIII are directly applicable, as, to secure rooting of the cuttings, there is just as great need for deep and fine working of the soil, pressing of it around the cutting, and for careful culture during the growing season, as there is for such treatment of fruit-tree seedling or root graft. It is just as necessary, too, that the rooted cuttings should be carefully lifted and guarded from drying out while on the way from the nursery to permanent place. The reader is, therefore, referred to Chapter VIII for suggestions on preparation, laying out, and care of nursery ground intended for the rooting of grape cuttings.

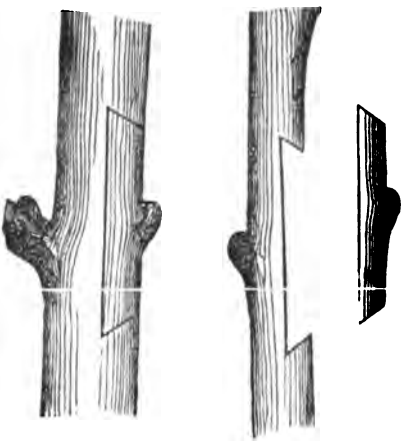
There is a growing tendency to use rooted vines instead of cuttings in planting out vineyard, for, although the former cost several times as much as the latter, either in the time of the grower or in cash outlay, the balance is believed to be usually on the other side, when the uniform stand and more satisfactory growth secured by rooted vines are considered.

BUDDING AND GRAFTING THE GRAPE-VINE.

Working over the grape-vine is largely practiced in this State and is easily accomplished. The occasion is twofold, replacing undesirable varieties with those of better quality, or in better market demand, and in bringing the *vinifera* varieties upon roots which resist the attacks of the phylloxera. The employment of resistant stocks has proved eminently satisfactory in this State, the resistant stock having been successfully installed even in the hole from which the dead *vinifera* root has been taken. For this reason resistant roots are largely relied upon in the planting of new vineyards in infested districts, and are also used in regions where the insect is not now found, by those who fear and desire to provide against its coming.

BUDDING THE GRAPE.—Buds can be readily made to grow in grape canes, though budding is not largely used. Mr. William Cantelow, of Vaca Valley, a fruit grower of long experience, reported at a recent meeting of the State Horticultural Society, that he had used the same method budding that is common with fruit trees, as described on pages 110 and 111. He finds it desirable to insert the bud in the spring as soon as the bark will slip well on the stock, and before the run of the sap is too strong. Budding in mid-summer, as with fruit trees, has not succeeded with him. He puts away cuttings in a cool place so their growth will be retarded, and then seizes upon just the right condition

of the stock, inserts the bud under the bark of a cane of the previous season's growth, ties it around with a string, and finds that the bud starts readily without further treatment. When its growth shows its ability to take the sap, the top of the stock is removed.



INLAYING A BUD IN A VINE CANE.

Another method of budding the vine is by inlaying a piece of wood with the bud, as shown in the engraving. The use of a narrow waxed band would probably be desirable with this style of budding. It takes considerable ingenuity to make a good fit of bud and stock for inlaying, and it is but little done. It offers a way, however, to rapidly multiply wood of some desirable variety, by securing a cane from each bud.

GRAFTING THE VINE.—Grafting in old vine roots is a simple operation, and is performed in various ways. The principles involved in vine grafting are similar to those affecting tree grafting, as described in Chapter IX. The processes employed are also similar, but the graft requires less binding and covering, because it is usally made beneath the surface of the ground, and is, therefore, less subject to accident, exposure, and drying out.

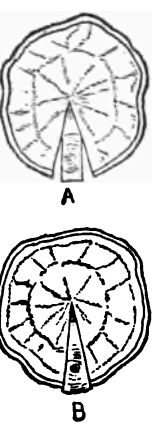
GRAFTING IN THE OLD STUMP.—This is resorted to when the character of the vineyard is to be changed, as in changing vines of the old mission variety to some improved wine variety, and more recently in changing wine varieties into raisin sorts. Out of the many ways for working into old stumps, two are given below, as those most commonly employed in this State.* The first is called "lateral cleft grafting" and introduces the scion by a side cut into the stock without splitting across. The earth is removed from the old vine down to its first lateral roots, and the top is sawed off cleanly a few inches above the first laterals. A cut is then made into the side of the stump with a knife and mallet, as is shown in the figure. The scion is then

*The engravings used in this connection are from Mr. J. H. Wheeler's translation of the French Treatise on Grafting, by Aime Champin, published by the Viticultural Commission, in 1883.

cut long enough so that one bud will remain above-ground when the surface is leveled again, the bottom of the scion being given an oblique wedge-shape, so as to fit the crevice in the stock. Some care is needed in shaping the wedge of the scion. A fit like that shown in *A* in the sketch will not succeed, while one in which the surfaces are in contact, as in *B*, will give good results.

MAKING THE SIDE CUT INTO THE VINE ROOT.

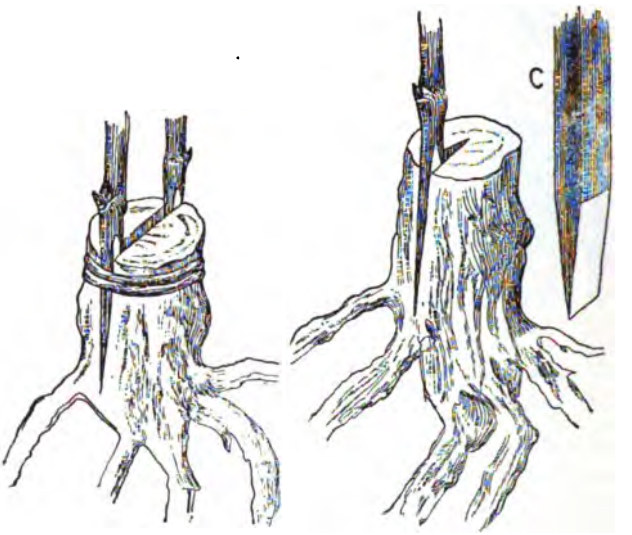
The manner of inserting the scion is shown by an engraving on the following page, which also pictures a wedge which is used to force the cleft open a little. If the cut is well made and the end of the scion so adjusted that the stock will pinch it when it is pushed into place, nothing more will be needed except to smear over the cut surface of the stump and the joint of the scion and stock with clay or with a mixture of two parts clay and one part fresh cow manure. If the scion is held firmly and sealed in with this mixture, it usually needs no tying, and the hole can be carefully filled with loose earth, with a strong stake to mark the place of the graft, and to which the new growth can be securely tied afterwards. Another common method is to split the stump across its center and insert one or two grafts, as shown in the figure. If two are used and both grow, the weakly one is afterward suppressed. In this cross cleft graft some grafters rely upon the stock to hold the scion without tying, and daub it over with the clay mixture, care being taken to fill and cover the split in the stock to exclude water. Others put a ligature around the split stump, as shown in the engraving. Strips of cotton cloth answer well for this purpose. Tying offers better security from knocking out the graft with the cultivator.



ADJUSTMENT OF SCION TO STOCK.

In grafting into very tough old stumps, some growers leave a slim wedge of wood in the cleft with the scion to prevent the stock from closing too forcibly upon the scion.

SIDE GRAFTING.—Side grafting the vine is commended by some growers. It consists in inserting a graft by a cut into the side of the stock, the method being essentially the same as that employed with fruit trees, as described on page 116, except that in side grafting the vine the top is not amputated, but is allowed to bear its crop and is then removed the following winter. The



COMMON CLEFT AND LATERAL GRAFTS. SCION IN POSITION.

next summer the scion will bear a crop, and the vine is worked over without cessation in its bearing.

HERBACEOUS GRAFTING.—This term is applied to a graft in which the scion of the current season's growth is set by a cleft graft into canes also of the current season's growth, while both scion and cane are elastic, but not too soft. The method has not been usually successful in this State, apparently because of the dryness of the summer air.

CARE OF SCIONS.

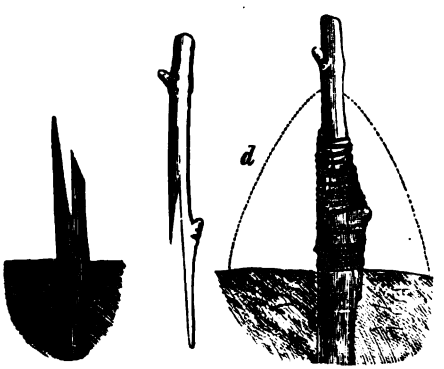
For taking and caring for scions, John H. Wheeler, ex-chief viticultural officer, who has given much attention to grafting old vine stumps, advises as follows:—

Too much emphasis cannot be given to the value of properly caring for the wood to be used for scions, which should be cuttings, or, better still, whole canes as pruned from the vine. These should be imbedded, when taken from the vine, on the north side of some building, in trenches covered well with earth. For this purpose they may be tied into bundles or left loose. Do not be afraid that they will rot. A little mold on them would prove no injury. From these, the operator may, in the spring, cut small or large scions, long or short, wasting no buds.

Grafting is done in February, March, and April in different parts of the State, March being the month usually chosen for the work. If a spring graft fails, the stump may be regrafted in August or in the following spring. In regrafting, the stump is cut off again below the previous cleft. Mr. C. J. Wetmore favors August grafting, and thinks it could, with advantage, be more widely resorted to. The time for the work is when the sap has ceased flowing, usually from the 1st to the 10th of August.

GRAFTING ON RESISTANT ROOTS.

Grafting on resistant roots differs from working in old stumps in the size of the wood to be operated on, and in the fact that the graft must be set higher up because it is not desirable to have the scion strike roots of its own, for the obvious reason that depending on such roots would make the vine no longer resistant. The advantage of covering the graft with earth is, however, still to be enjoyed, for the earth can be raised in a little mound around the graft, to be removed when the graft has taken well. For this reason grafting on resistant roots is usually done at or near the surface of the ground.



WHIP GRAFT WITH EARTH MOUND.

The common cleft graft is used when the stock is large enough to give a split strong enough to hold in the scion. In grafting smaller stocks the whip graft is used, as shown in the accompanying engraving, which represents the stock, the scion, and the two after insertion and tying, with the dotted line to show the mound of earth made to keep the graft from drying out.

This graft is variously treated. It is covered with clay by some, by others with grafting wax; but the common experience is that grafting wax makes too tight a joint, and holds in surplus sap, which begets disease. The use of a wax band specially adapted to ruling conditions has proved very successful in the hands of a prominent vine grower, who describes his practice as follows:*

Take old soft muslin—the coarser the better—cut it *across* the grain into narrow slips half an inch wide and eight inches in length; arrange the slips in bundles of one

* Eli F. Sheppard, of Madrone Vineyards.

hundred each, for convenience in applying the wax; melt, in a shallow iron pan, a pound each of beef tallow and beeswax; add four ounces of resin; heat the whole to the boiling point. Then take the bundle of prepared muslin slips and dip *one-half* its length only into the boiling liquid, take it out quickly, and hang up in a cool place till the wax hardens, and the bandages are ready for use. The bandage so prepared is applied as follows: After carefully inserting the graft in the cleft, begin a little below the joint and wrap the dry or *un*waxed end of the bandage closely and firmly three or four times spirally upward around the cleft, completely covering it; when the *waxed* portion of the bandage is reached, draw it tightly around, going spirally downward and over the now covered cleft joint until the whole is completely inclosed, air-tight, with the waxed cloth. Press the bandaged joint gently between the thumb and forefinger to close up any exposed points, and carefully cover up the graft to the terminal bud with dry, fresh earth.

Though several species of American wild vines have been found practically resistant in this State, the California species, *Vitis Californica*, and the riverside grape, of the Eastern States, *Vitis Riparia*, have been most widely employed as resistant stocks. Of late there has been a tendency toward the *Æstivalis* varieties, notably the Lenoir and Herbemont. The *Riparia* is, however, most widely employed at present. Concerning the selection and treatment of these stocks and their adaptation to different soils and to the support of different *vinifera* varieties, there is much information available in the special publications commended in the opening of this chapter.*

LAYING OUT THE VINEYARD.

Vines are planted in rectangles, generally in squares, but sometimes at a less distance in the rows than the rows are from each other. The stakes which are to represent the future vines are in either case placed by the same methods of measuring or marking off. All the methods described for clearing and preparing lands, in Chapter VII, and for laying off ground in squares, described in Chapter X, are applicable to vineyard ground. The measuring wire described on page 129 is the means usually employed for laying off. A special contrivance which has been used to some extent on level ground in Los Angeles County is thus described:†

Straight rows, equidistant on level land, are essential to good cultivation. To have straight rows on hilly or uneven land will require more care and a little skillful engineering. Perhaps it would pay the proprietor who plants a vineyard on hilly land to avail himself of the services of a competent surveyor to set flags at the ends of his rows, and others at intervals between the ends along the rows, for the guidance of the marker. Too great care cannot be given to have all the rows on both hilly and level land perfectly straight, for the beauty of the vineyard and the ease of cultivation.

The marker most in use is made in the form of a sled, sixteen, fourteen, or twelve feet long, with three runners so placed as to mark rows eight, seven, or six feet wide. These runners should be made about three feet long, of some hard wood (Oregon pine will do), two inches thick and firmly nailed to two planks placed upon them of

* See pages 367, 368.
† B. H. Twombly, Tustin, in Los Angeles *Herald*, March, 1887.

the lengths first above named. Upon these should be bolted two strong pieces of joist in the form of wagon hounds projecting in front far enough to receive a stout pole like a wagon-tongue, well braced and fastened with an iron rod. Care must be taken that the motion of the machine is steady and true in all its parts. With a well-made marker, a gentle team, and a careful driver, excellent work may be done. Some of the best vineyards in this vicinity, one of fifteen, one of ten, and one of three acres, were marked with a wheelbarrow. Of course the rows should be laid off both ways.

DISTANCE OF PLANTING.—There is as much difference of opinion and practice in fixing the distance between vines as between orchard trees, but usually more room is given than formerly. Planted in squares, the distance varies from seven to ten feet, with eight feet as most prevalent, taking the State as a whole. Distances for the *chaintre* system will be given later.

Planting in parallelograms is also adopted to some extent for the sake of getting space to spread trays for raisin drying and for other reasons. Such plantations are made with the vines seven by ten or eight by ten feet, four and one-half by eleven feet, etc. There is great variation in the distances.

When the distance between the vines is very much less than the distance between the rows, it is termed "planting in rows." Charles Krug, of Napa County, a prominent vineyardist, has recently reached results which incline him strongly to advise the planting in rows. He first adopted the practice of planting three and one-half feet apart in the rows, and the rows fourteen feet apart, because of the easier plowing of such a vineyard on the hillside, and his experience disclosed so many advantages that he has since adopted the method on valley lands. Among these advantages he mentions: Plowing can be done with a double team and larger plows; the brush can be gathered and burned between the rows instead of carrying it to the avenues; sulphur and materials for spraying can be brought in by team to any part of the vineyard; empty boxes can be distributed and filled ones gathered up without carrying, etc. Planting in rows recommends itself not only for planting new vineyards, but also for changing old vineyards from seven by seven feet to three and one-half by fourteen feet, or from eight by eight feet to four by sixteen feet, giving the proprietor an opportunity to change from a *vinifera*-root vineyard to a resistant-root vineyard. This can be accomplished by planting resistant roots in the alternate rows to be preserved, right between the two old vines.

NUMBER OF VINES TO THE ACRE.—Whether the vines be set in squares, parallelograms, or in rows, it is very easy to calculate the number of vines which an acre will accommodate. Multiply the distance in feet between the rows by the distance

the plants are apart in the rows, and the product will be the number of square feet for each plant; which, divided into the number of feet in an acre (forty-three thousand five hundred and sixty), will give the number of plants to the acre.

AVENUES IN THE VINEYARD.—For convenience of access with team and wagon, there should always be avenues through the vineyard. They are usually arranged so as to cut up the vineyard into blocks about twice as long as broad, if the vineyard be on level land. Of course, on hilly lands the avenues should be located for ease of hauling. The avenue is made by leaving out a row of vines, and, therefore, the exact size of the block will depend upon the distance between the rows. Some advise having not more than forty vines between the avenues. Planting in rows with wide spaces between the rows renders fewer avenues necessary.

PLANTING CUTTINGS AND ROOTED VINES.

Various means are used for planting cuttings. An essential condition to successful growth is to have the lower part of the cutting well embedded in the soil, as it will not root unless in close contact with the earth. To lack of care in this regard most failures are due, and for lack of surety that such contact is made the various contrivances for speedy planting, such as the planting bar, are widely condemned; an excavation of the hole and refilling with fine surface earth, just as advised in Chapter XI, for planting orchard trees, is commended as the safest practice. Much, however, depends upon the soil. In loose, free soil such a use of bar or "sheep's-foot" as will be presently described may be satisfactory, while it would be impracticable on firmer soils, both because of the difficulty of insertion and because the packed condition caused by the forcing in would not favor root extension, and not desirable on shallow soils because the contact of the better surface soil with the bottom of the cutting will stimulate the growth of the cutting, and is, therefore, very desirable. The planting by direct thrust is obviously impracticable when horizontal planting of a long cutting is desired, as will be described later.

The post-hole auger and a device for taking out soil as a "trier" takes out a sample of cheese or butter, have also been used to some extent, but not widely, in making holes for cuttings.

PLANTING BAR AND SHEEP'S-FOOT.—The following methods, described by Dr. Gustav Eisen* as prevailing in the raisin districts of the San Joaquin Valley, on sandy, loamy soils, will well illustrate similar methods wherever followed:—

* San Francisco *Examiner*, Oct. 5, 1883.

The planting bar consists of a bar of hard iron, sharpened at the lower end and furnished with a cross-handle at the other. The length of the bar is about three and a half feet, width about two and a half inches, and thickness a third to half an inch. If less than this the bar will bend. The planting is done by pushing the bar perpendicularly in the ground. After withdrawing it, insert the cutting and push it down to the bottom. Fill up the hole by again inserting the bar in the ground close by and pressing the flat side against the hole.

The sheep's-foot consists of a round rod with cross-handle at the upper end. The lower end of the rod is slightly flattened, bent, and forked. The planting is done by fitting the forked end over the butt-end bud of the cutting, and immediately pushing cutting and rod together to the desired depth in the soil. A slight twist is now given to the sheep's-foot. This loosens it from the cutting and allows it to be withdrawn. A tamp with the foot fills the hole. Great care must be taken in withdrawing the sheep's-foot, lest in doing so the cutting should be drawn out also, and this will leave a fatal air chamber at the lower end. The slight twist given the rod before withdrawing loosens it and leaves the cutting undisturbed.

For planting in dry situations some careful planters run water and fine earth into the hole made by the bar after inserting the cutting; others run in fine sand dry and then pour on water. In using water in this way one must take care that he does not use adobe earth, for a succeeding dry spell may bake it, and the cutting will be worse off than if not puddled.

It has been found that a handful of bone meal mixed with the earth at the bottom of the hole is conducive to growth of cutting or rooted vine.

PLANTING LONG CUTTINGS.—Where the long cutting planted more or less horizontally is adopted, the method of the late G. G. Briggs, one of the largest grape planters of the interior valleys, may be followed. This is his description of his practice:*

I make my cuttings of wood of the previous season's growth, about three feet long. I lay out vineyard with a plow, crossing furrows at right angles at the distance desired for the vines. At the intersection of the furrows, dig holes twenty inches deep and twenty inches long, and the width of a shovel. The holes should be dug all on the same side of the furrows, or in a corresponding angle of the intersecting furrows. The butt of the cutting is placed from the intersection, bringing the top at the exact intersection, with two buds above the surface. The end of the hole at the intersecting part must be perpendicular, so as to give the top of the vine a perpendicular position from the elbow of the vine at the bottom of the hole. To make this elbow when the vine is placed, slip the foot on the cutting and cover with soil and tramp down. I have found this mode of planting the most successful. It gives a larger amount of roots than perpendicular planting, and the roots are low enough below the surface to be out of the reach of ordinary drought, and the same time none are so deep as to be cold and slow of action in circulation. In covering, be careful to place the soil close about the perpendicular part of the cane, and up full with the general surface, but back from this part the hole may be left in the form of a sink, to catch and hold moisture during the first rainy season.

PLANTING ROOTED VINES.—Planting rooted vines is governed by the same rules commended for planting trees in Chapter XI, so far as preparation of holes, care in placing and firming the soil around the roots, etc., is concerned. In handling

**Record-Union*, July, 1882.

rooted vines there must be greater care in packing and transportation to prevent the roots from drying, and in carrying to the field it is generally advised that the plants be kept in a pail or other receptacle with water. The vine roots are very small and tender, and success will largely depend upon good care of them. At planting all dead roots should be trimmed away and the top reduced to a single cane cut back to two eyes.

WHEN TO PLANT.—The exact time to plant cannot be stated, for the condition of the soil and the local season-points are the best guides. Planting can be done much later as a rule in the coast regions than in the interior, because the soil is usually later in getting into good condition of mellowness and warmth, and the late rains are usually heavier. It is certainly not advisable to place cuttings in cold, wet soil, and dry soil will quickly destroy their vitality. The suggestions given on page 145 should be carefully considered. The planter must use good judgment in choosing his time for planting, aided in forming it by the best local experience he can get.

CULTIVATION OF VINEYARD.—General suggestions concerning the cultivation of the vineyard have already been given in Chapter XIII, preceding.

CHAPTER XXVI.

PRUNING AND CARE OF THE VINE.*

MOST of the varieties of *vinifera* grown in California at present thrive under the short pruning system. There are exceptions, however, which will be noted later. The prevalence of the short pruning system frees our growers from the expense and inconvenience of trellises. Though in the early years of the vines stakes are used, our older vines stand by themselves and are as independent of supports as are our fruit trees. The vines are, in fact, shaped upon something the same model as our fruit trees, the so-called "goblet form" of the French being our prototype.

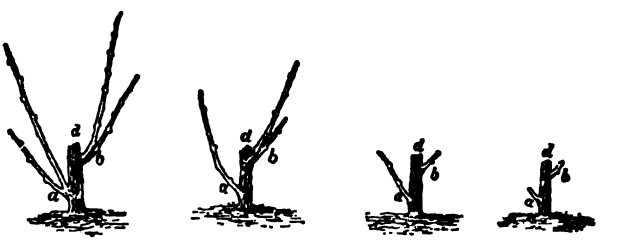


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

VARIOUS GROWTHS OF VINES BEFORE FIRST PRUNING.

An effort will be made to describe briefly how this form is attained.†

FIRST YEAR.—During its first year in the vineyard the cutting is allowed to make all the growth possible without interference. After the fall of the leaves the following winter, the vines will be found to have made varying amounts of growth, according to individual vigor, as shown by the accompanying engraving, ranging from Fig. 1, which is a good growth, down to Fig. 4, which is a feeble growth. In these figures *d* represents the wood of the cutting which was planted with two buds above-ground; *a* is the lowest shoot of each, which, in the first three instances,

*A general discussion of the pruning of the vine, with due consideration of all the ends to be attained by different pruning policies, is beyond the unavoidable limitations of this treatise. The literature of the subject is large, and anyone who aims to make a specialty of the grape will of course seek other sources of information. It is the aim of the writer merely to give a few suggestions which will aid the beginner or one who designs to grow a small area of vines in connection with other fruits.

†The figures used herewith are from a translation of Cazenave's treatise, published by the Viticultural Commission.

Figs. 1, 2 and 3, should be cut back to two buds, and all the other shoots removed entirely, leaving, however, the old stem *d* in each case, as it is useful to tie the new shoots to during the following summer. In the case of the feeble growth, Fig. 4, the shoot *b* is to be removed and *a* allowed to stand as it is, in the prospect of its picking up strength and making growth enough to be cut back to two buds at the end of the next season.

Thus it appears that usually all the vines cannot be brought to uniform condition at once, but some will require a year or two more than others in the shaping process, because of the inherent weakness of the individual, or because some of the vines may be set in a spot of the vineyard less favorable to growth.

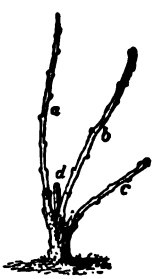


FIG. 5.

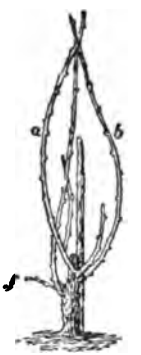


FIG. 6.

FIG. 7.

VINE AT SECOND AND THIRD PRUNING.

SECOND YEAR.—During the second summer, vigorous vines will send out shoots five feet or more in length, according to the inherent strength of the variety or the favoring situation, and of these the most upright and vigorous should be selected to serve as the foundation of the future trunk. It should be cut back so that the second bud from the top of the part that is left shall mark the height desired for the first fork of the coming goblet-shaped head. This cane should be tied to a stake and all other buds save the three at the top rubbed off. All other canes should be closely cut away. The engraving, Fig. 5, shows at *a* the cane to be chosen to form the future vine, while *b* and *c* are to be cut away cleanly.

At this point practice varies in this State. Instead of rubbing off the lower buds, as advised, some growers allow laterals to grow below the future head and the laterals bear fruit and are afterwards cut away. The result is that a trunk is afterwards formed with scars from the removed laterals instead of smooth

trunks, which are secured when the lower buds are rubbed away. The grower has to decide whether this fruit is worth more to him than the healthier and more vigorous vine which will probably be secured by dispensing with this early fruit.

Another point of difference enters here, and that is the choice of height at which the head of the vine shall be formed. By the head is meant the point at which the lowest branches emerge from the main stem, and not the tops of the highest spurs, which some call the head of the vine. The question is, then, at what point shall the oldest or lowest forks be formed. Experince favors low-heading on hillsides and on broad valley vineyards. The grapes are brought near to the warm, dry soil, which, with raisin and table grapes, at least, is desirable because the radiation of heat from the sun-heated soil during the night gives a more uniform heat during the twenty-four hours, and, by bearing its fruit low and supporting part of it upon the ground, the vine is less affected by wind. But this very low heading is not desirable on moist soils because of mildew, nor is it safe on low ground where frosts are likely to form. For this reason in broken country where vineyards run from the hillsides down into small valleys, it is usual to head the vines on the low ground higher than on the hillsides.

THIRD YEAR.—During the third summer canes will grow from the vines something as shown in Fig. 6, and considerable fruit will be borne. Sometimes all these canes are allowed to grow through the season, but it is better practice to rub off other

FIG. 8.

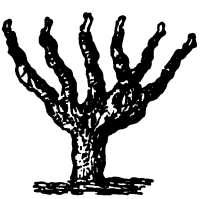


FIG. 9.

FIG. 10.

THE VINE AT FOURTH AND SUBSEQUENT PRUNINGS.

shoots when two or three vigorous ones can be selected to form the main branchings of the trunk. It is also customary to pinch off the main shoots after they have grown out a foot or so. This pinching results in the growth of leafy laterals which shade the fruit and add to the stockiness of the main canes. At the winter pruning which follows, these two or three main canes are cut back to two or three buds, the greater number of buds being

left on the more vigorous vines. All other shoots are cut away cleanly. This operation fixes the first fork of the vine head, as shown in Fig. 7.

FOURTH YEAR.—The fourth summer most vines will put forth a number of canes and bear a good crop of fruit, though some varieties are later in bearing. The same treatment is given the vine as during the preceding summer, and at the following winter pruning each branch is allowed to retain two spurs of two or three buds each, according to the strength of the vines, as aforesaid. Thus the vine which was left as in Fig. 7 at the third pruning becomes the form shown in Fig. 8 at the fourth winter pruning.

SUBSEQUENT PRUNING.—After the fourth year the pruning proceeds upon the same plan, the number of branches being increased as the vigor of the vine seems to warrant, until the trunk

A STUMP-PRUNED VINE.

shows the goblet form, as shown in Figs. 9 and 10. From year to year the number of buds left on the spurs depends upon the ability of the vine to produce the fruit and make a healthy growth.

STUMP PRUNING.—Short or spur pruning is also followed without systematic effort to build up a symmetrical trunk, branching in goblet shape, as has been described. In such practice the vine is usually headed as soon as a strong cane is thrown out

about as high as the top of the trunk is intended to be, and year after year shoots are selected from those emerging near the top of the stump. Irregularly-branching heads are thus formed, continually crowding upward, and are kept within bounds much less easily than low-heading branches. The engraving shows a stump-pruned vine with some canes cut short and some long, according to a system which will be mentioned presently.

In stump pruning there is a difference of practice as to low heading according to locality. In the interior regions the vine is now headed almost at the surface of the ground; in the coast regions there is usually a stump of one to two feet or more. As with trees so with vines, the practice is to prune to make lower heads than during the early years of California fruit growing.

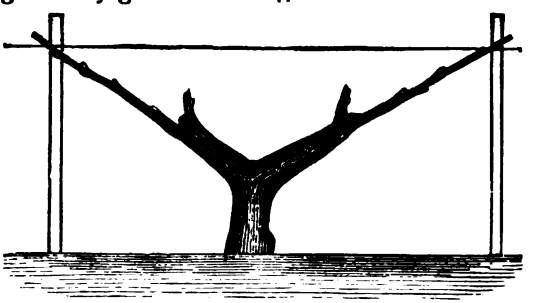
AN INSTANCE OF LONG PRUNING.

LONG PRUNING.—Some varieties grown for market and for raisin making do not thrive if pruned by the short-spur system. Notable among these are the Sultana, the Emperor, and the Sabalskanski vines. There are also a number of wine varieties which must be pruned long. Long pruning admits of degrees, but it usually signifies using a five or six instead of a four-foot stake and leaving the selected canes from eighteen inches to three feet or longer instead of cutting back to two or three buds, as in short pruning. These long canes are securely tied to the long stakes.

With varieties needing long pruning the first two or three buds next the old wood do not bear fruit, hence the need of leaving buds farther removed from the old wood to secure it. This habit of the vine invites the practice of growing a long cane for fruit and at the same time providing for wood growth for the following year's fruiting by cutting another cane from the same spur down to two or three buds. By this practice the wood which has borne the fruit is cut back to a bud each winter and the cane which has grown only wood is pruned long for the fruit of the following summer. A modification of the practice is to prune the canes from some of the spurs long, and from other spurs short, thus making the spurs alternate from wood bearing to fruit bearing from year to year. Sometimes instead of using a long stake the long cane is brought over the top of the vine and lashed to the

trunk on the other side; or two or more canes are thus brought over from side to side and tied securely at their crossing. The engraving shows one style of long pruning, which illustrates the cutting to long and short canes, and will sufficiently indicate the system. The number of long canes to be left to the vine depends on its vigor, and this can only be learned by experience.

The Eastern grape varieties do not succeed with short-spur pruning, and the few vines of these varieties found in our vineyards are generally grown on long stakes. The use of the trellis



LONG PRUNING AND THE USE OF A TRELLIS.

is rare, for it is expensive and unhandy in cultivation. Still there are a few grapes on trellises, chiefly in gardens, though the use of the trellis for certain varieties, which seem to thrive better when lifted from the ground, is extending, especially in the region near the coast. The engraving shows long pruning with renewal short canes trained upon trellis.

THE CHAINTRE SYSTEM.—This is another method of long pruning, which is now being thoroughly tested in the Livermore Valley. It is of French origin, the term *en chaintre* meaning "trailing chains." It consists in growing long canes, which, when fruiting, are supported upon short, forked stakes, so that the clusters hang within a few inches of the ground, as shown in the engraving, which represents a branch of a chaintre-trained vine in fruit. Full descriptions of the method of procedure in bringing a vine from time of planting to the development of the chaintre form, also a report of several years' experience in this method of training, can be found in the publications of the Viticultural Commission.*

It may be stated, however, that vines *en chaintre* are set about six feet apart in the rows, and the rows twelve to eighteen feet apart, the less distance on the lighter soil. The vines are

*Appendix 1 to report of State Viticultural officer for 1882-83, and report on the chaintre system in California by Clarence J. Wetmore, in report Viticultural Convention of 1888, page 72.

spread out over the wide spaces between rows during the summer, but, after being properly pruned, are turned back to admit of cultivation of the ground. Mr. Wetmore finds the chaintre system better than trellises, because the land can be plowed both ways, and cheaper, as well as some other respects better than other systems of long pruning. His essay on the subject describes some local improvements in the system which have been introduced to better suit California conditions.

MATERIALS USED IN TRAINING VINES.—The chief item of cost in vine training is the stakes. The best stakes are of California redwood, which is exceedingly durable. The cost of four-foot stakes for short pruning is about $12 per thousand and for five and six-foot stakes for long pruning about $15 to $18

THE CHAINTRE SYSTEM OF LONG PRUNING.

per thousand, free on board cars in the redwood regions in Sonoma and Santa Cruz Counties.

Vines are tied with "grape twine," old cable (bought at the junk shops in San Francisco), with wire, with the tough leaves of the New Zealand flax, and with withes of ozier willow. Both of the last-named materials are now grown for home use by many vineyardists. Plants of New Zealand flax (*Phormium tenax*) have been for several years furnished free to applicants at the State University at Berkeley. Professor Husmann strongly commends No. 16 annealed galvanized wire for making the upper ties of young vine stumps to stakes, and uses the other materials for the lower ties and for fastening up growing canes.

For the chaintre system Mr. Wetmore uses at first light redwood stakes, which cost from $6.00 to $10 per thousand, and these same stakes are afterwards used as supports under the trailing vines in connection with forked stakes made by taking two pieces of redwood (one-half inch by three-fourths inch, eighteen

to twenty inches long) and wiring them together about four inches from the top. They are spread apart when put under the vine. The cost of the small forked stakes is about $3.00 to the acre per year, as the number required increases until the vines attain full growth.

Grape-vines should be tied tightly to the stake. By "tightly" is meant tight enough to prevent a chafing motion, without compressing the cane. The object of tying up vines is to prevent their being blown about by the wind and the breaking of the canes. Some, however, tie loosely, and are careful to have the vine on the leeward side of the stake. Split stakes should have the corners rounded to prevent chafing of canes.

SUMMER PRUNING AND SUCKERING.

Summer pruning or topping of vines is usually practiced. Some follow the pinching process, by which the terminal of the growing cane is nipped off with the thumb and finger when it has grown out about two feet. Others wait longer and then slash off the ends of the canes with a sickle. The tendency is to leave summer pruning until too late and to slash off wood indiscriminately, to the injury of the vine. Summer pruning, if done early enough, and this would be while the growth is still soft at the point of removal, will induce the growth of laterals and will shade and improve the fruit, and at the same time thicken the growth of the main cane and strengthen its connection with the spur. Slashing of canes too late in the season deprives the fruit of the service of enough leaf surface for the elaboration of the sap, often seriously checks the growth of the vine, and in hot regions induces sunburn. The first summer pruning should be done as soon after the bloom as it would be considered safe, without disturbing the blossoms by the jarring of the canes. The second could take place whenever the canes or laterals extend beyond the length necessary to shade the grapes.

Suckering is an important process and usually has to be attended to at least twice in the season. It consists in removing all shoots from old wood which are not provided for at the previous winter pruning. The growth of these suckers takes sap which should go to the other canes. All such shoots should be rubbed or pulled off while they are still soft; if a sucker puts out at a point where it would be desirable to have a spur to balance the head of the vine, it should of course be allowed to grow, to be cut back to two buds the following winter. By such selection of suckers new spurs are secured to replace old and failing ones.

GENERAL NOTES ON PRUNING.

Longer or shorter pruning produces effects not only upon the amount and early ripening of the fruit of certain varieties,

but upon quality, as shown in the wine. Such effects have to be discerned by local observation.

It is a very difficult matter to lay down any rule for pruning a vineyard, so much depends on the age of the vines, the different varieties, and the quality of the soil. A basis on which to build a theory on the subject might be found in and through an understanding of the quantity of grapes that may be expected from a vine, as the secret of pruning is to keep a just medium between the production of grapes to the injury of the vine and its wood and an overproduction of wood to the detriment of the crop. In older vines a proportion should be maintained between the vigor of the vines and the crop desired; each bud may be considered good for two bunches of grapes the ordinary size, and upon this estimate may be obtained. It must be borne in mind that the result of overloading the vine is detrimental to its vigor and health, while the reverse will not injure it, but will lessen the profits for that season, often giving greatly increased returns in after years.*

Close attention should be given to the growth of the wood and fruit of the preceding year. If the canes are very large and the bunches of grapes poor and there are many suckers, it indicates that more eyes are necessary. On the contrary, if the canes are small and the bunches of grapes numerous and straggling, and the ripening not even, it indicates that the number of eyes left should be less.

Pruning should also be regulated to produce a good second crop of grapes or to prevent the formation of a second crop. The second crop is often desirable in raisin and table varieties, but undesirable to wine varieties.

Attention should be paid to the tools used in pruning. Let the blades be kept sharp and thin; large shears are very apt to bruise the wood more than small ones.

Pruning is done after the fall of the leaves and before the swelling of the buds, usually in January and February. Early pruning has a tendency to make the vines start growth early, consequently in frosty situations pruning is often deferred till late in the winter. In such situations it is advised to leave more buds at pruning, so that if the frost kills the first shoots there are buds below to make later growth. This practice has been followed with marked advantage in some regions liable to late spring frosts.

DISEASES OF THE VINE.

One of the most prevalent diseases of the vine in California

*L. D. Combe, San Jose.

is caused by *Uncinula ampelopsidis* (formerly known as *oidium*), a fungus which affects leaves, canes, and berries, and is locally known as "mildew."* This disease is recognized by grayish white coloring of the affected leaves, which, as the disease progresses, shrivel and dry up; the young cane also blackens and dries and the berries show whitish patches, which become darker colored and the berries crack open. The usual remedy for the trouble is finely-ground or sublimed sulphur applied several times during the season. The application is made with a "dredge" or a bellows. The dredge is a tin cylinder with a handle at one end like that of a "sugar scoop" and the opposite end perforated finely. Another form resembles the spout of a watering-pot, the sulphur entering through the handle, and fine gauze covering the face instead of perforated metal. By a proper movement of the arm the sulphur in the cylinder is thrown against the perforated end, and enough finds egress from the small holes to shower the vine. The dredge is best fitted for use on small vines or for use early in the season, when the growth is just starting from the stump. When larger spread of sulphur is desired, the bellows may be used. There is much difference of opinion and practice as to times of sulphuring. It may be said, however, in a general way that the remedy should be a little in advance of the disease, and in regions where the mildew appears regularly, sulphur is applied about as soon as growth starts in the vine. A second application about at blooming-time, and a third when the berries are the size of peas. Where mildew is not of regular occurrence it is usual to await the appearance of the disease before sulphuring, and often such frequent application is not necessary. There is much difference in locality as to prevalence of mildew, also in the susceptibility of different varieties, and it is found that in some regions bringing

THE SULPHUR BELLOWS.

* It should be noted that the "black rot" (*Locstadia Bidwellii*) and "anthracnose (*spaceloma ampilinum*) have not yet been detected in California, nor does the climate seem to favor their existence, judging from what is known of conditions which favor their spread in other parts of the world.

the vines nearly to the surface of the ground gives escape from the disease. In sulphuring always walk with the wind and guard the eyes as much as possible.

Another fungicide which is being successfully used in this State both for the *uncinula*, for the *peronospera*, and for other possible fungoid growths which do not yield to the sulphur treatment as the *uncinula* does, is known as the "copper-lime" remedy or "Bordeaux mixture," a prescription reported to the French Academy by M. Millardet, and first published in California by Professor Hilgard, as follows:*

The treatment consists simply in sprinkling upon the vines, by means of a little broom, a fluid mixture made thus: Dissolve in twenty-five gallons of water sixteen pounds of copper sulphate (bluestone), also slake thirty pounds of quicklime with seven and a half gallons of water into a milk of lime, which then mix with the bluestone solution; there will thus be produced a light blue mixture, which should be frequently stirred during use. Care should be taken not to sprinkle the grapes themselves. About thirteen gallons were used per one thousand vines. After drying, the droplets remain firmly fixed to the leaves, and a few, or even one on each leaf, appear to be sufficient to produce the effect. A very weak solution of both lime and copper is, therefore, spread over the leaf each time the latter is moistened, but even a strong rain cannot wash the active drop entirely away. It remains and protects the vine during the season, as the French experiments have shown.

The copper-lime remedy is applied in various ways in this State. It is sprinkled on, as the French advise, it is rubbed on the stump in the winter with a brush or a sponge wired to a stick, to kill any resting spores of fungi, and it is applied with a spray pump to the vine leaves when in growth, both before and after the blooming, but not while in blossom. Mr. Haraszthy has found it a cure for dropping of leaves in July, which sometimes did much harm in his vineyard until he began using this wash in 1885.

Recent experiments at the East with various applications for fungoid diseases of the grape and of fruit trees, have led to modification of the original French preparations. The following formulas have been found satisfactory.†

Ammoniacal Carbonate of Copper.—Into a vessel having a capacity of two quarts or more, put one quart of commercial ammonia (strength twenty-two degrees Baumé); add three ounces carbonate of copper; stir rapidly for a moment and the carbonate of copper will dissolve in the ammonia, forming a very clear liquid. This concentrated liquid may be kept indefinitely. For use, dilute to twenty-two gallons.

Bordeaux Mixture.—Dissolve six pounds of sulphate of copper in sixteen gallons of water. In another vessel slake four pounds of quick lime in six gallons of water. When the latter mixture has cooled, pour slowly into the copper solution, care being taken to mix the fluids thoroughly by constant stirring. Prepare some days before using. Stir before applying.

Eau Celeste.—Dissolve one pound of sulphate of copper in two gallons of hot water. When completely dissolved and the water has cooled, add one and one-half pints of commercial ammonia. When ready to use, dilute to twenty-two gallons.

**Pacific Rural Press*, Nov. 14, 1885.
†"Horticulturists' Rule Book," by Professor L. H. Bailey, pages 39-41.

A second method of preparing *eau celeste:* Dissolve one pound of sulphate of copper in two gallons of water. In another vessel dissolve one pound of carbonate of soda. Mix the two solutions, and when chemical action has ceased, add one and one-half pints of commercial ammonia. For use, dilute to twenty-two gallons. A modification of this latter method is two pounds sulphate of copper, two and one-half pounds carbonate of soda, and one and one-half pints of commercial ammonia, prepared as before.

A frequent misfortune of the vine, and for which no remedy is yet known, is coulure, a term signifying the failure of the fruit to set or to remain on the cluster. This occurs in varying degrees from the loss of a few berries to the almost complete clearing of fruit from the stem. It is worse with some varieties than others. It is worse in some localities than others. The trouble is believed to arise from various causes.

There is, also, occurring with more or less frequency, a reddening and death of the vine leaves, supposed to be identical with the trouble known to the French as "rougeole." The leaves show light-colored spots at first, which afterward turn red and finally involve the whole leaf or cane, and sometimes the whole vine. It usually occurs in midsummer, and is not necessarily fatal in its effects.

An evil occurring on the main stem of the vine, generally near the surface of the ground, is an excrescence of woody character commonly called "black knot." There has been much discussion as to the cause of this abnormal growth, without full agreement among observers. Some attribute the knots to injuries to the stump in cultivation, others to outbursts of sap which the short pruning system does not give top growth enough to dispose of, and to various other causes. The usual treatment is to cut away the knot, pare the wound smooth, and cover with paint or shellac solution. This disease should not be confounded with the "black knot" of the plum, the cause of which is well understood.

There has prevailed for several years a mysterious disease of the vine in Southern California, known as the "Anaheim disease," because its evil work first appeared in that vicinity. It has destroyed several thousand acres of vines, but of late it has, fortunately, been decreasing. The disease has thus far baffled scientific inquiry. The fullest statements concerning it can be found in the Report of the United States Department of Agriculture for 1889.

A number of insects infest the vine more or less seriously in this State, of which the chief will be mentioned in the chapter devoted to that subject.

CHAPTER XXVII.

GRAPE VARIETIES IN CALIFORNIA.

As previously stated, there have been large collections of grape varieties brought into California during the last thirty-five years. They were sought in all grape countries, and from such wide experimental planting a few have survived in popular esteem and are now chiefly grown. Being derived from different countries, they came bearing many names. Some of these have been preserved, some wholly lost, and replaced with local appellations. The result is that our grape nomenclature is full of confusion. Some varieties have been identified by the means of the standard French grape literature; others are apparently unknown to the compilers of that literature. It is, therefore, impossible to-day to determine a number of our most popular table and shipping grapes, as well as some of the wine varieties. In order to characterize our leading table grapes, descriptions will be quoted from the best available local authorities, as follows:—

EARLY BLACK JULY; syns. *Madeleine, Madeleine Noir*, etc.—"Leaves rather small; light green above and beneath; bunches small and compact; berries small, quite round; skin thick, black, covered with a blue bloom; flavor moderately sweet, but not rich nor perfumed. The earliest grape, and chiefly valued for the dessert on that account."—Hyatt.

EARLY MADELEINE; syn. *Madeleine Angevine.*—"Moderate grower, with long-jointed, brown wood; leaf medium, deeply lobed; dark green above, tomentose below; young points reddish, woolly, slender; bunch medium, compact, shouldered; berry medium, oblong, yellowish green, transparent, rather thick skin, sweet and juicy. Vine a shy bearer when pest is prevalent."—Husmann.

CHASSELAS DE FONTAINEBLEAU; syn. *Sweetwater.*—"Vine a strong but slender grower, which will bear well with short or long pruning, low or high stakes; wood brown, long-jointed, slender; leaf thin, deeply lobed, bright green, ends of shoots and young leaves brownish green; bunch medium, compact, shouldered; berry medium, round, yellow, transparent, of a peculiar, crackling firmness, juicy, sweet, but without any very high character."—Husmann.

CHASSELAS ROSE.—Fruit resembling foregoing, except that both bunch and berries are usually smaller, and flavor is more pronounced.

CHASSELAS VICTORIA.—"Vine vigorous, very short-jointed and brittle, and bears well with short pruning; wood grayish yellow, thick and strong; leaf light green, deeply lobed and shining; young shoots with numerous laterals; bunch very large and heavy, often weighing five pounds, shouldered, very compact; stem brown, very thick; berry medium, round, pale lilac purple, with lilac bloom, juicy, vinous, refreshing."—Husmann.

PALOMINO; syn. *Golden Chasselas.*—"The vine quite largely grown as 'Golden Chasselas' is undoubtedly identical with the Listan, or Palomino."—Professor Hilgard. "Vine a fair grower; wood close-jointed; leaf medium, oblong, deeply lobed, bright green above, grayish green and tomentose below; stem short, young points with reddish tint and woolly; bunch large, conical, rather loose and shouldered; berry round, full medium, sometimes flat, pale green with yellowish tinge; thin skin, juicy and sweet, resembling Chasselas."—Husmann.

BLACK MALVOISE; syn. *Malvasia.*—"Vine a strong grower; wood long-jointed, rather slender, light brown; leaf medium size, oval, rather evenly and deeply five-lobed; basal sinus moderately open, with parallel sides, upper surface smooth, almost globrous, lower surface lightly tomentose on the veins and veinlets; bunches large, rather loose, branching; berries large, oblong, reddish black, with faint bloom; flesh juicy, flavor neutral."—Hilgard. Widely grown as an early table grape.

MISSION.—"This variety, grown at the old Missions, has never been determined, nor its exact source ascertained. It is by some regarded as a most delicious table grape. It can be found in small areas in every county of the State adapted to the grape. Vine a strong grower; wood short-jointed, dull dark brown to grayish; leaf above medium size, slightly oblong, with large, deeply-cut, compound teeth, basal sinus widely open, primary sinuses shallow and narrow, secondary sinuses ill-defined, smooth on both sides, light green below with light scattered tomentum."—Hilgard. "Bunches slightly shouldered, loose, divided into many small, distinct lateral clusters; berries medium size, round, purple black, heavy bloom; exceedingly sweet, juicy, and delicious; seeds rather large; skin thin."—Hyatt.

WHITE MUSCAT OF ALEXANDRIA.*—"Vine a short, rather straggling and bushy grower, well adapted to short stool pruning, as it forms rather a bush than a vine; wood gray, with darker spots, short-jointed; leaf round, five-lobed, bright green above, lighter green below; young shoots a bright green. The laterals produce a second and even a third crop; bunch long and loose, shouldered; berry oblong, light yellow when fully mature, transparent, covered with white bloom, fleshy, with thick skin, very sweet and decidedly musky."—Husmann. The leading table grape of California. Rejected for irregular bearing on some mesa lands in Southern California, but mentioned by Dr. Eisen as the prevailing raisin grape in that portion of the State.

MUSCATEL GORDO BLANCO.—"Muscatel Gordo Blanco has a closer bunch and rounder berry than the Muscat. The skin is softer and the pulp is not quite so hard. The berries incline to be a little darker in color and not nearly so green when it is ripe, and I think not quite as long as the Muscat of Alexandria. If the Muscat would set as well as the Muscatel, the difficulty would be obviated. One very important difference is that when you come to dry them, the Muscat of Alexandria loses the bloom very rapidly. The bloom comes off when you come to dry and pack them. But the Muscatel does not lose its bloom. The Muscat of Alexandria has to be dried a little more than the Muscatel to bring it into a keeping condition under the same condition of ripeness."—R. B. Blowers.†

The growth of the Muscatel or Gordo Blanco vine is low and spreading, with no upright branches in the center; clusters heavy, and, when perfect, close and shouldered; berries round and large (the greatest circumference being at the center), a crease often being found at the apex of the berry; color green, or, when fully ripe, amber green or yellow. Distinguished from Muscat of Alexandria by low, depressed growth of vine, closer cluster, rounder berries, and by thicker and finer bloom. The Muscatel is the choice raisin grape for the San Joaquin Valley, and for the interior generally.‡

HUASCO MUSCAT.—A variety brought from Chile and now gaining in favor as a raisin grape.

* There is much doubt about the White Muscats as grown in California. Some claim inability to distinguish between certain grapes of the Muscat type which are being grown in this State under distinctive names; others pronounce them clearly different varieties. The matter cannot be adjudicated at present.

† At Fresno Grape Growers' Convention, 1883.

‡ Condensed from Dr. Eisen's "The Raisin Industry," page 87.

FEHER SZAGOS.—Vine a strong grower and heavy bearer; branches erect but slender; leaves glossy entire; bunches medium to small, pointed, and solid; berries greenish amber, medium oval, pointed, with thin skin and few small seeds; flesh not firm, but dries well and makes a good raisin."—Dr. Eisen.

LARGA BLOOM; syn. *Uva Larga.*—A variety of Muscat said to be named because of the length of its berries, but held by some growers to be indistinguishable from Muscatel Gordo Blanco. An excellent raisin grape, but now chiefly grown as a table fruit in the Santa Cruz Mountains.

WHITE MALAGA.—"Vine a strong grower; wood reddish brown, short-jointed; leaf medium, leathery, smooth, deeply lobed, light shining green above; bunch very large, loose, shouldered, long; stem long and flexible; berry very large, oval, yellowish green, covered with white bloom; thick skin, fleshy."—Husmann. Grown in Southern California in situations where the Muscat does not do well; also elsewhere as a table grape, and to some extent in San Joaquin Valley for raisins.

BLACK MUSCAT OF ALEXANDRIA.—"Bunches large, shouldered; berries large, oval; skin thick, of a reddish color, becoming black at maturity; flesh quite firm, with a rich, musky flavor."—Downing. Growing in popularity as a table grape.

SULTANA; syn. *Seedless Sultana.*—"Vine a strong grower; brown, long-jointed wood; leaf thin, bright green above, lighter green below, smooth and shining, deeply lobed and sharply serrate; young wood dark green, points grayish brown, tendrils at every joint, thin and slender; bunch very large and loose, shouldered; berry small, round, golden yellow, covered with light bloom, sweet and juicy, firm and crackling, without seeds; an abundant bearer with long pruning."—Husmann.

THOMPSON'S SEEDLESS.—Named by Sutter County Horticultural Society, after W. Thompson, Sr., of Yuba City, who procured the cutting in 1878, from Ellwanger & Barry, of Rochester, New York. It was by them described as "a grape from Constantinople, named Lady Decoverly." When it fruited in Sutter County, it was seen to be superior to the Sultana, and has been propagated largely. It has been widely distributed by J. P. Onstott, of Yuba City, and others, and is now to be found in all parts of the State. The variety is described by Dr. Eisen as follows: "Oval; greenish yellow; as large as a Sultana; seedless with thin skin; good, but not strong flavor, and without that acid which characterizes the Sultana grape and raisin; bunches large or very large; vine an enormous bearer."

FLAME TOKAY; syns. *Flame-colored Tokay, Flaming Tokay.*—"Vine a strong grower, large in all its proportions, wood, joints, leaves; wood dark brown, straight, with long joints; leaves dark green, with a brownish tinge; lightly lobed; bunch very large, sometimes weighing eight to nine pounds, moderately compact, shouldered; berry very large, oblong, red, covered with fine lilac bloom; fleshy and crackling, firm; ripens late."—Husmann. The leading show grape of the State and desirable for shipping; quality low.

BLACK HAMBURG.—"Bunches very large, from six to ten inches in length, very broad at the shoulders, tapering to a point gradually; berries very large, round, slightly inclining to oval; skin rather thick, deep purple, very black at maturity; very sugary, juicy, and rich."—Hyatt. A very popular market grape.

ROSE OF PERU; syn. *Black Prince* (?).—"Vine a strong grower, with dark brown, short-jointed wood; leaf deep green above, lighter green and tomentose below; bunch very large, shouldered, rather loose; berry round, large, black, with firm and crackling flesh; ripens rather late; a very handsome and productive variety, of good quality, but not adapted for long shipment."—Husmann.

PURPLE DAMASCUS; syn. *Black Damascus.*—"Vine a medium grower; wood light brown striped with darker brown, short-jointed; leaf round, five-lobed, smooth, light green above, tomentose beneath; stem reddish, large, long and woody; bunch large, loose, shouldered; berry very large, oblong, dark blue, covered with lighter bloom, meaty, skin thick, ripens late."—Husmann.

BLACK CORNICHON.—"Vine a strong but stocky grower, with thick, close-jointed brown wood; leaf large and thick, deeply five-lobed, dark green above, grayish green and tomentose below; young shoots light green, with tomentose points; bunch very large, loose, shouldered, with long stems and drooping; berry large, long, dark blue with lighter dots, fleshy thick skin; very late."—Husmann.

EMPEROR.—"Vine a strong grower; wood long-jointed, brown; leaf half rough and large, deeply lobed; bunch long and loose, shouldered, very large; berry oblong,

THOMPSON'S SEEDLESS GRAPE AS GROWN BY J. P. ONSTOTT, NEAR YUBA CITY, SUTTER COUNTY.

deep rose-colored, covered with light bloom; thick skin, firm."—Husmann. An excellent shipping grape, largely grown by R. B. Blowers, of Woodland, Yolo County, by whom its merits were first announced. Pronounced unsatisfactory because of irregular setting and non-ripening in localities near the coast in Northern California, and generally condemned in Southern California. Seems best adapted to early interior situations.

BLACK FERRARA.—A large black grape; large bunches; berries cling well to he stem, thick-skinned, flavor superior. An excellent local market variety and long-distance shipper.

BLACK MOROCCO.—"Vine a straggling, drooping grower, with numerous laterals, which generally bear an abundant second crop; leaf thin, deeply lobed and serrated, dark green and shining; bunch very large, rather compact, heavily shouldered; berry very large, black, fleshy, of rather poor quality."—Husmann. A showy market variety, standing shipment well. Often rejected because of prevalence of black knot on rich soils.

VERDEL.—(*Aspiran Blanc.*—Hilgard.) "Vine a strong grower; long joints; leaf large, deeply lobed, tomentose; bunch short, heavily shouldered; berry oblong, yellow sh green, covered with fine bloom; ripens late, very productive."—Husmann. Largely grown as a late table grape; usually deficient in sweetness.

There are many other *vinifera* varieties which are grown to a limited extent either for raisins or for table use. Among these are the Canon Hall Muscat, the Muscat Frontignan, White Tokay, White Cornichon, Gros Colman, White Champion, Cinsaut, Sabalskanski, etc., for table use; the White and Black Corinth, for drying. With grapes, as with other market fruits, the planter usually confines his attention to a very few popular kinds.

EASTERN GRAPES.

Though many of the improved varieties of the grape species indigenous east of the Rocky Mountains, and of the hybrids between these species and the *vinifera*, have been introduced in California, their growth for table fruit is almost of insignificant proportions, and does not constitute even a respectable fraction of one per cent of our grape area. The popular taste decidedly prefers the *vinifera* varieties. There is, however, a variety believed to be of local origin, which is worthy of mention, as follows:—

ISABELLA REGIA.—"A remarkable, giant-leaved, and very prolific variety, or, rather, sport, of the Isabella, produced by Mr. J. P. Pierce, of Santa Clara. The berries, like the leaves, are of extraordinary size, and when ripe the fruit is exceedingly sweet and strongly aromatic. It is, therefore, acceptable as a showy, perfumed table grape, much liked by some, but readily surfeiting those who are accustomed to the *vinifera* grapes. The berries are too soft for shipment to any distance, but, all things considered, keep fairly."—Hilgard.

TABLE GRAPES CHIEFLY GROWN IN CALIFORNIA.

The tabular statement on the following page embodies reports from local growers of the varieties found most profitable for market in the counties specified. As with the foregoing tables, in the chapters on other fruits, the asterisks indicate affirmative reports, and the absence of the star does not necessarily imply that the county is unsuited for the grape, nor that the varieties named do not succeed there.

TABLE EMBODYING REPORTS FROM GROWERS OF TABLE GRAPES, NAMING VARIETIES CONSIDERED MOST SATISFACTORY IN THE COUNTIES INDICATED.

COUNTIES OF CALIFORNIA.	Madeleine	Chasselas Font.	Palomino	Black Malvoise	Mission	Muscat of Alex.	Mus Gord. Blo	Large Bloom	White Malaga	Black Muscat	Sultana	Flame Tokay	Blk Hamburg.	Rose of Peru.	Purp. Damasc.	Purp. Cornich.	Emperor	Black Ferrara.	Blk Morocco	Verdal
Del Norte	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Humboldt	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mendocino	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lake	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Napa	*	*	*	*	*	*	.	.	.	*	.	*	*	.	.	.	*	.	.	*
Sonoma	.	*	*	*	*	*	.	.	.	*	.	*	*	*	.	.	.	.	.	*
Marin	.	*	.	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Contra Costa	.	*	.	*	*	*	.	.	.	.	.	*	*	*	.	.	.	*	.	*
Alameda	.	.	*	*	*	*	.	.	.	.	.	*	*	*	.	.	*	*	.	*
Santa Clara	.	.	*	*	*	*	*	*	.	*	*	*	*	*	*	.	*	*	.	*
San Mateo	.	.	.	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Santa Cruz	.	.	.	*	*	*	*	*	.	*	.	*	.	*	*	*	.	*	.	*
San Benito	.	*	.	.	*	*	*	.	.	.	.	*	*	*	.	.	.	.	.	*
Monterey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
San Luis Obispo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Santa Barbara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ventura	.	.	.	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Los Angeles	.	*	*	*	.	.	.	.	*	.	.	*	*	*	.	.	*	.	*	.
San Diego	.	.	.	*	*	.	.	.	.	.	*	*	*	*	.	*	*	.	*	.
San Bernardino	.	.	.	*	*	.	.	.	*	*	*	*	*	.	.	*	*	.	*	*
Kern	.	.	.	.	*	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tulare	*	*	.	*	.	*	.	.	.	.	.	*	.	*	*	.	.	.	.	.
Fresno	.	.	.	.	*	*	*	*	*	.	*	*	.	*	.	*	.	.	*	.
Merced	.	.	.	.	.	*	*	.	.	.	*	*	.	.	.	.	.	.	.	.
Stanislaus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
San Joaquin	*	*	.	.	*	*	.	.	.	.	.	*[1]	*	*	.	.	.	*	.	.
Sacramento	.	*	.	.	*	*	.	.	.	.	*	*	.	*	.	.	.	.	.	.
Solano	*	*	.	*	.	*	*	.	.	*	*	*	*	*	.	.	*	*	.	.
Yolo	.	.	.	.	*	*	*	.	.	.	.	.	.	.	.	.	*	.	.	.
Sutter	.	.	.	.	.	*	*	.	.	*	*	.	.	.	.	.	.	.	.	.
Yuba	.	*	.	.	.	*	*	.	.	.	*	*	.	*	.	.	.	.	.	.
Butte	.	*	.	.	.	*	*	.	.	.	.	*	.	.	.	.	.	.	.	.
Colusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tehama	.	*	.	.	.	*	*	.	.	.	.	.	.	*	.	.	.	.	.	.
Shasta	.	.	.	.	.	*	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trinity	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siskiyou	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Modoc	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lassen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plumas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sierra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nevada	.	*	*	.	*	*	.	.	.	.	.	.	*	*	*	.	.	.	.	.
Placer	.	*	*	.	*	*	.	.	*	.	.	*	*	*	*	*	*	.	*	.
El Dorado	.	*	.	*	*	*	.	.	.	.	.	*	.	*	.	.	.	.	.	.
Amador	.	*	.	*	*	*	.	.	.	.	.	*	.	*	.	.	.	.	.	.
Calaveras	.	*	.	*	*	*	.	.	.	.	.	*	*	*	.	.	.	.	.	.
Tuolumne	.	.	.	.	.	*	.	.	.	.	.	*	*	*	.	.	.	*	.	.
Mariposa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alpine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mono	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inyo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Allusion has already been made to the growth and greatness of the wine-grape interest of California. Progress is being continually made in the propagation of varieties yielding the best qualities of wine, and in the manufacture thereof. The hosts of considerations involved in this effort are beyond the scope of this work, and in great part beyond the knowledge of the writer. The undertaking is also an unfinished one, and much remains to be demonstrated by local experience and by scientific investigation. The best sources of informations available are the publications commended on pages 367, 368. These, and the publications which will hereafter appear from the same sources, should be sought by the inquirer into matters connected with the wine industry.

It will be interesting, however, to introduce lists of the grapes more less widely grown in this State for the various kinds of wine, and these lists will be compiled from the reports of Professor Hilgard, adopting his classification, as follows:—

SOUTHERN FRENCH TYPE.—A. *Red.* Alicante Bouschet, Aramon, Carignane Grenache, Cinsaut, Clairette Rouge, Etraire de l'Adhui, Gros Colman, Mataro Mourastel, Sirah, Serine, Petit Bouschet, Ploussard, Trousseau, Black Malvoisie. B. *White.* Chasselas de Fontainebleau, Chass. Rose, Chass. Victoria, Chauche Gris, Clairette Blanche, Frontignan (Muskateller, Muscat Blanc, etc.), Roussanne, Marsanne, Ugni Blanc, Verdal, Folle Blanche, Burger (so-called).

BORDEAUX OR CLARET TYPE.—Cabernet Franc, Cabernet Sauvignon. Malbeck, Merlot, Verdot, Gros Mancin, Tannat, St. Macaire, Beclan, Gamay, Mondeuse, Gamay Teinturier, Teinturier male, Grossblaue, Blue Portuguese, Affenthaler, Blue Elbling.

BURGUNDY TYPE.—Franc Pinot, Petit Pinot, Pinot Noirien, Pinot Noir (P. de Pernand, de St. Georges, etc.), Meunier, Robin Noir (Pfeffer's Burgundy), Chauche Noir. *White.* Pinot Vert dore, Pinot Chardonay.

SAUTERNE TYPE.—Sauvignon Blanc, Sauvignon Vert, Semillon Blanc, Muscadelle du Bordelais.

RHENISH TYPE.—Johannisberg Riesling, Franken Riesling, Welsch Riesling, Orleans Riesling, Kleinberger (True Burger, Putzscheere), Traminer, Ruländer, Black Hamburg.

NORTH ITALIAN TYPE.—Refosco (Crabb's Black Burgundy), Barbera, Fresa, Bonarda, Nebbiolo, Aleatico, Marzemino, Peverella, Spanna. "Of these only the first has been somewhat extensively cultivated, but this class is likely to be of the greatest importance in the future."

HUNGARIAN AND AUSTRIAN.—Feher Szagos, Green Hungarian, Kadarka, Lagrein, Rothgipfler, Slancamenka, Stainschiller, Zinfandel.

PORTS.—Bastardo, Moretto, Tinta Amarella, Tinta Cao, Tinta Madeira, Tinta Val de Peñas, Pied de Perdrix (Alvarelhao).

SHERRY AND MADEIRA.—Beba, Boal Madeira, Malmsey, Mantuo de Pilas, Mission, Mourisco Branco, Mourisco Preto, Palomino, Peruno, Pedro Jimenes, Verdelho, West's White Prolific.

AMERICAN.—Agawam, Barry, Catawba, Concord, Cunningham, Clinton, Diana, Elvira, Goethe, Golden Champion, Golden Queen, Herbemont, Hartford, Iona, Ives, Isabella, Isabella Regia, Lenoir, Taylor, Wilder.

Other varieties are also grown, but this list includes those most largely used at present.

PART FIVE: SEMI-TROPICAL FRUITS.

CHAPTER XXVIII.

THE DATE.

THE date palm (*phœnix dactylifera*) was brought to California by the padres, as has been mentioned in Chapter V, and the oldest date trees in the State are the survivors of their early plantings. These trees are found at the San Diego mission, as shown in the engraving. They are conjectured to be a century old, and they have survived drought and neglect, making unsuccessful effort at fruiting, for, according to common report, the fruit does not ripen, but whether owing to the unfavorable conditions indicated, or to lack of fertilization of the bloom, is not known. There are handsomer trees at Ventura, on the site of the garden of the old mission of San Buena Ventura. They are described as about forty feet in height and ten feet in circumference at the base, with long, graceful, fern-like leaves, which put forth about thirty feet from the ground.

The ill success of these old trees in the direction of fruit bearing probably long prevented further attention to the date as a profitable growth. Still there were date palms grown from seed of the commercial date planted here and there for ornament or out of curiosity, and in due course of time the fruit appeared. Interest slowly awakened to the possibility of planting the date for profit, and induced more careful inquiry into the adaptation of California conditions to the successful growth of the tree. The first public exhibition of California dates known to the writer was made at the Mechanics' Institute Fair, in San Francisco, in September, 1877. The fruit was grown on the south bank of Putah Creek, the northern boundary of Solano County, the situation being slightly above the level of the plain of the Sacramento Valley, which lies east of it. The plants were grown by J. R. Wolfskill, from seed of commercial dates purchased in San Francisco, and planted in 1858 or 1859. The seed germinated readily, and the young plants were set out in a row about one hundred feet south of Putah Creek, on a rich, fine, sandy loam, lying about twenty-five feet above the bed of

the creek. The plants received good cultivation but no irrigation. This treatment was continued after the property passed into the hands of S. C. Wolfskill, the plants being allowed to remain in the row as originally planted, and they have attained great size, considering their crowded condition, as shown in the engraving. They are approximately six feet apart, have trunks about two feet in diameter, and are twenty-five feet or more in height. The engraving shows the large clusters of fruit situated at the base of the leaves.

DATE PALM AT THE SAN DIEGO MISSION.

Another bearing date palm stands about a mile eastward of the situation just described, near the residence of J. R. Wolfskill. It was grown from seed of the date of commerce, which was planted in 1863, and the tree bore its first fruit in 1880. In

the plate which shows this tree there also appears upon the left a taller date palm, which bears staminate bloom, as will be mentioned presently. This latter tree was originally one of the row previously described, and was successfully moved to its present situation after attaining considerable size.

The fruit of these two bearing palms differs notably in appearance. That of the first-mentioned tree is of bright yellow color and angular outline; that of the second tree is wine red, with smooth surface. Both are borne upon bright yellow, cord-like stems, which converge into the flattened, smooth, polished bright yellow stalks, which emerge from between the leaf stems.

DATES GROWN AT S. C. WOLFSKILL'S, NEAR WINTERS, CAL.

The engraving, which was drawn from a fruit sample from the yellow-fruited palm, will give an idea of the form of the date cluster, and the shape of the berries. The weight of the cluster shown was about twenty-five pounds, and there were four larger ones on the tree when this was removed.

REQUIREMENTS OF THE DATE.

The successful fruiting of the palms described led Mr. W. G. Klee to make special inquiry into the requirements of the date palm and the suitability of California conditions for its growth. The results were published by the United States De-

partment of Agriculture.* Mr. Klee's conclusions may be summarized as follows:—

There exist in California many localities where dates would ripen, and undoubtedly would prove a great acquisition. This fruit has ripened on Putah Creek, near Winters, Solano County, on a tree raised from seed, bearing about as early as in Egypt and Algeria. The few date palms grown outside of this region have been in localities too near the sea, or, rather, with too cool a temperature, where, according to all accounts, they never have ripened. When we consider that the propagation of the varieties of date palms developed during its long culture is chiefly carried on by means of the sprouts, the seeds being used only in the most favorable localities, the case of ripened dates in as high a latitude as 38° N. is of great significance. It proves the importance of one of the factors for successful date growing possessed by California climate, viz., a long, dry, rainless season. A temperature not lower than 18° Fahr. will not hurt good-sized trees, provided it occurs between November and March—that is, outside the period of flowering and fruit ripening; nor will the hot winds of the worst kinds hurt this palm, the home of which is the desert, and to the condition of which its nature seems to be perfectly adapted.

The date palm, when supplied with even alkali water, will thrive in a climate too hot for any other fruit tree known, giving shade to plants that otherwise would suffer from the heat.

Besides the locality already mentioned, the date has fruited at Santa Barbara, Fresno, at Santa Ana, in Los Angeles County, and probably at other California points, as well as near Phœnix, Arizona. There is little doubt that it will succeed in any of the interior regions which have a sufficiently high summer temperature, and even the so-called Colorado Desert may be dotted with groves of date palms, as portions of it now are with groves of the majestic fan palm of California.

SOILS AND WATERS FOR THE DATE.—In California thus far the date palm has only been planted on good orchard land, but, according to experience in date-growing countries, the tree does not require rich soil, but, on the contrary, will thrive in a soil poor in humus—too poor and too purely mineral for any other fruit tree; and it produces the finest and best-flavored dates, nourished by water too alkaline for man and beast to drink. These observations should lead to trials of the tree in situations not adapted to other fruits.

PROPAGATION OF THE DATE.

The date palm grows readily from the seeds of the dried date of commerce, and, as has been intimated, the trees now fruiting in this State have been obtained in this way. By the use of seed, one gets, however, only seedlings, and the chance of thus securing a really fine variety is probably not greater than with other fruit-tree seedlings. In date-growing countries the best varieties are propagated by rooting the off-sets, sprouts, or

*"Culture of the Date," by W. G. Klee, gardener in charge of agricultural grounds, University of California: Washington, Government Printing Office, 1883.

suckers which appear at the base of the old palms. To secure the best foreign varieties such plants must be imported. The first successful enterprise of this kind was accomplished in the summer of 1890 by the United States Department of Agriculture, under the direction of Professor H. E. Van Deman, chief of the Division of Pomology. The first lot imported was composed of nine trees (three trees of each kind), and came from Biskra, Algeria. They were five or six years old, and were taken from the ground where they were planted by the Arabs, the outer leaves having been cut off about three or four feet from the ground, and then planted in a box of earth. The second lot were from Cairo, Egypt. There were fifty-four in this lot, all planted in tubs, and arrived in excellent condition. There were six trees of eight of the choicest varieties known in Egypt, and six male trees. They were gathered from different parts of the country, and were intended for the British colony of Mauritius, but that government decided not to take them, and our consul-general at Cairo bought them. These are supposed to be the best varieties grown in Egypt and Algeria, and other importations are expected from the Euphrates region and from Persia. The plants received in 1890 were divided between New Mexico, Arizona, and California. The plants for California were sent to the Department of Agriculture of the University of California, and were planted at the experiment stations at Tulare and at Pomona. Here they will be fruited, and will serve as centers for propagation, whence the new plants will erelong be distributed to other favoring localities. The incoming of these dates is one of the most interesting events in our horticultural history, and may be in the future considered of great significance.

GROWING DATES FROM SEED.—As this method of securing date palms is readily available, and as possibly there may be really desirable varieties originated here, the following instructions for handling date seeds, by the late H. Von Borstel, a date grower of Lower California, are given:—

Large dates, with small, thin seed-stone, fine skin, and sweet, aromatic taste, should be selected. The seeds are placed, with the point of the seed where the stalk was down, in boxes eighteen inches deep, filled with sand and well-rotted manure. Place the seed two inches apart and cover about two inches deep with sand. Place the boxes in the sunshine, shade partially, and protect them at night. Water daily with water that is not cold. Planted in September or October, the shoots, which appear like grass blades, should be out of the ground by winter, and they are then transplanted when the soil is in good condition, taking care not to handle the roots. Holes two or three feet deep should be dug and filled with sand and well-rotted manure, the young plants placed therein, and watered after planting. After planting they require watering every eight to twelve days until the leaves are six or eight inches high, after which they will usually thrive without further watering if the soil can be kept moist by cultivation.

This practice may be varied considerably, of course, and any method which gives the young plant sufficient warmth and moisture after germination will be likely to succeed. Nor is it necessary to use sand in planting, providing the soil is light enough to withstand baking and cracking. The seed germinates with great readiness. Mr. Samuel H. Gerrish, of Sacramento, says he has seen the young plants springing up in the streets of that city, where date seeds have been thrown during the rainy season.

The seeds may be sown in open seed-bed, if slightly protected by cloth or lath frame, and the plants reset in nursery row to be placed in permanent position after attaining more size. They transplant well if a ball of earth is taken up with the roots.

If grown in boxes, which is, perhaps, preferable, because more easily watered and cared for, they may be afterwards potted for a time, but the plant should not remain long in the pot because of the circular growth soon assumed by the roots.

ROOTING SUCKERS.—Suckers taken off in warm weather and watered freely usually take root readily. Care should be taken not to let the plants dry. In growing plants from suckers one gets fruit much sooner than from seedlings.

BEARING AGE OF THE DATE.—There is, however, much difference in the ages at which the seedlings have come in fruit in the hands of different growers. H. Goepper, of Santa Ana, Los Angeles County, reports fruit on seedlings six years old. H. Von Borstel, of Lower California, secured fruit from plants four years from the seed. This early maturity cannot, however, be generally expected, though it seems likely that the date will bear quite as early as in the famous date regions of the eastern hemisphere.

TRANSPLANTING LARGE DATE PALMS.—Mr. Gerrish says he has had good success in "transplanting trees ten to fifteen years old by removing them in the summer months, taking off all the leaves except the five central ones, and cutting off half the length of these, and every day pouring a pailful of water over the top of the tree to keep it moist. With this treatment they may be as easily transplanted an any other tree. Be sure to give them a dressing of salt—it is the manure for a date tree, as it is a native of a saline soil." Of course, it is desirable to move as large a ball of earth with the roots as convenient to handle.

BLOOMING OF THE DATE.—The date palm is *dioecious*, and, its staminate (male) and pistillate (female) blooms appearing on different trees, it requires the association of the two for perfect fruiting. Growing plants from seed leaves the grower in doubt as to the sex of his plants until they bloom. Mr. Von Borstel obtained a large preponderance of male plants. In propagating from suckers the new tree is of the same sex as the parent. It is advised to have about one male to twenty female trees. The pollen can be transported long distances and maintains its vitality for a long time.

Artificial fertilization of the bloom of the bearing palm has been found of advantage in this State, and is practiced by J. R. Wolfskill. Though the staminate tree is but a few feet away from the pistillate, the male bloom is broken in pieces and hung to the leaves of the female tree near to the pistillate flowers. It is found that the parts of the date cluster which are nearest to the suspended male blooms have more perfect fruit than the more distant parts.

In Winters the bearing palms bloom in April or May, and the fruit ripens in November.

BEAUTY OF THE DATE PALM.—The date palm in fruit is a beautiful sight. The glaucous green pinnate leaves arch outward. Between two of these emerge the bright orange yellow polished fruit stalks, which divide into a spray of slender bright yellow stems a foot or so in length; and thickly set upon these in clusters are the coral red date berries, covered with a rich bloom. It is a sight not easily forgotten by a lover of nature, and especially by one reared in a Northern zone, the characteristic vegetation of which is so different.

CHAPTER XXIX.

THE FIG.

THE fig is, perhaps, the grandest fruit tree of California. Its majestic size and its symmetry make it a crowning feature of the landscape, and its dense foliage renders the wide space embowered by it a harbor of refuge from midsummer heat, both for idlers and for the industrious. On adjacent farms in Pleasant's Valley, Solano County, there are large fig groves; one serves as a shelter for the packers of fruit from the contiguous orchard, and the other incloses and shades a croquet ground. Measurements of large trees are abundant, for old trees are numerous in the interior of the State, both in the valley and on the slopes of the Sierra foot-hills. At Knight's Ferry, in Stanislaus County, there is, in the orchard of George A. Goodell, a fig tree sixty feet in height, with branches of such length as to shade a circle seventy feet in diameter. The trunk at the base is eleven feet around, and nine feet at a distance of three feet from the ground. A little higher the trunk divides into seven or eight large branches, each of which is nearly five feet in circumference. At thirty feet from the ground the limbs are seven and eight inches through. The largest grove in the neighborhood of Knight's Ferry is owned by J. H. Prouse, and consists of fifteen massive black fig trees, which, though set sixty feet apart, mingle their branches overhead and form a network through which, in the summer, hardly a beam of light can pass. Beneath their branches, at midday, a heavy twilight prevails, and a person entering their shade from the sunlight without experiences a sensation of entering a darksome cave.*

Such groves are frequently seen in the older settled parts of the State. Perhaps the most interesting single fig tree is that on Rancho Chico, quite near the residence of General Bidwell. It was planted in 1856, and has attained a marvelous growth. One foot above the ground the trunk measures eleven feet in circumference; the widespreading branches have been trained toward the ground, and, taking root there, banyan-

*Modesto *Herald*, July 17, 1888.

like, they now form a wonderful inclosure over one hundred and fifty feet in diameter. The tree is loaded every year.

The crop on these large trees is proportionate to their size, and, entering their area in the morning during the ripening season, one can scarcely step without crushing figs, though the fruit is gathered up each day and placed in the sun for drying.

REGIONS SUITED FOR THE FIG.

Though there are still many fine points to be determined as to what situations and conditions favor the production of the very finest figs, and there are indications that there is possibly much difference, it may be truly said that a very small part of the State is really unsuited to its growth. If one shuns the immediate coast of the upper part of the State, where the summer temperature is too low for successful ripening, and keeps below the altitude on the mountains where winter killing of the tree is possible, he can grow figs almost anywhere. Robert Williamson, of Sacramento, an experienced grower, said:*

> It is a thoroughly demonstrated fact that the fig tree will grow most luxuriantly, thrive, and bear great crops, on most all of our valley, plains, mesa, and foot-hill lands, from one end of the State to the other. The warm, dry alluvial soils, and dry, warm climates of the interior valleys and foot-hills, seem to be peculiarly adapted to its successful culture and curing. It will grow and bear good crops of fruit on lands too dry to mature other fruits. It will also do well on our rich, moist bottom lands, provided they are well drained. So that there is no fruit that can be more generally grown all over our State than the fig, and no other with so little care and risks, or that is more profitable in the end, if we get good varieties and handle the fruit properly.

Selection of varieties adapted to particular situations has much to do with the success of the fig, as with other fruits, and, therefore, a broad statement of adaptability must be received with such an understanding. This fact is well pointed out by W. B. West, of Stockton, as follows:—

> Experience has shown us that the common black fig of California will grow and produce an abundant crop in almost every part of this State, and many, reasoning from this, believe that all kinds will do equally as well. This is a great mistake. The more tender varieties of white figs, which grow freely in the south of Europe and Asia Minor, will not succeed except where the nights, as well as the days, are warm, and where there is moisture enough in the soil to produce good trees. Such places are to be found in the foot-hills of the Sierra Nevada, especially on the margin of the rivers, where the soil is deep, rich, and moist, in the warm valleys of the Upper Sacramento and San Joaquin, in Vaca Valley, and in many other warm localities. In a large portion of San Joaquin and Sacramento Counties the nights are too cold, and, except in sheltered places, the trees will not mature in their fruit. The same will be the case in all counties under the same climatic influences.

These unfavorable influences to which Mr. West alludes are the intrusion of the coast temperature borne eastward by the

*Essay at Sacramento Fruit Growers' Convention, 1886.

trade winds of summer, as described in Chapter I. As these winds are warmer in Southern California than in the upper parts of the State, the area of successful fig culture draws nearer to the coast at the South than at the North.

Present indications are that the finest dried figs, having the thinnest skin and the nearest approach generally to the fig of Smyrna, the commercial standard for dried figs, have been produced on the foot-hills of the Sierra Nevada. At the same time excellent dried figs have been profitably produced in other situations. More time is requisite for the final demonstration of these matters.

SOILS FOR THE FIG.

As it must be left with the future to determine the mooted point as to the influence of special situations upon the bearing of the fig, and the more minute characteristics of the fruit, so more experience is needed to demonstrate the comparative effects of different soils. It might seem, from the fact of the age of our trees in different parts of the State, that time enough had elapsed to determine these points, but it must be remembered that all our oldest trees are of the variety found at the missions, and conclusions drawn from them as to all varieties is unsafe, as Mr. West has pointed out.

The fig will thrive in any soil that one would think of selecting for any of our common orchard trees, and, in fact, the fig succeeds on a wider range of soils than any one of them. Mr. James Stewart, of Downey, Los Angeles County, gives his experience, as follows:—

> I have been for the last fifteen years in the experimenting and the testing of different varieties of figs and the soil best suited to their growth. My observations have been that they do well on almost any kind of soil. I have some growing on high, dry, sandy soil, where it is twenty feet down to water; also some on a rich, sandy loam, about ten feet to water. Again, I have them growing on stiff adobe, not more than five or six feet to water, and they all grew vigorously and well.

This experience agrees with that of fig growers in other parts of the State, and one is safe in planting figs for family use, or for marketing, wherever the summer temperature is high enough to ripen the fruit well, and the winter temperature high enough to preserve the life of the tree. This applies merely to the successful growth of the fig; to secure ripening at a time when the fruit can be profitably sold for table use, is another question.

The selection of soils especially suitable to the production of the best figs for drying involves more considerations than rule in the growth of table fruit. For drying, the fig should attain a good size, but should not contain excess of moisture. In some parts of the State the first crop of figs in the season has

been found unfit for drying. The second, and, in some localities, the third crop, appearing later in the season, when the moisture supply of the soil is reduced, dries well. This condition of the first crop is, however, affected by local conditions, for there are places in the Sierra foot-hills where the soil moisture has to be replenished early in the season by irrigation to prevent even the first crop from falling prematurely, and subsequent irrigation brings to perfection the second and third crops. The fig tree needs plenty of moisture in the soil, but not too much. As with other fruits, if the soil does not retain the needed amount naturally, it must be supplied by irrigation wisely administered.

PROPAGATION OF THE FIG.

The fig grows very readily from cuttings, and this is the chief method of propagation. Cuttings should be made while the tree is fully dormant, in the winter, of well-matured wood of the previous season's growth, giving preference to stocky,

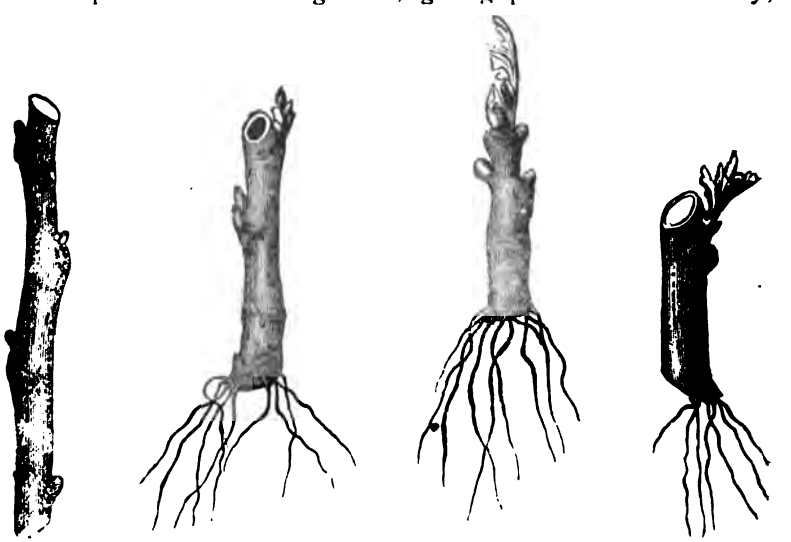


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

GROWTH OF FIG FROM CUTTINGS—LELONG.

short-jointed shoots, and making the cuttings about six to eight inches in length. The cut at the lower end should be made at the joint, or made where solid wood is found. The planting and care of the cuttings is essentially the same as of vine cuttings, as described on page 375. If well made and cared for, a very satisfactory growth is made the first season, and the trees are ready for planting out in permanent place the following season.

SINGLE-BUD CUTTINGS.—If one desires to multiply a new variety very rapidly, single-eye cuttings will make plants. This is, also, analogous to single-eye grape cuttings, as described on page 372.

The engravings show different styles of fig cuttings. Fig. 1 is the cutting usually employed, and its start in bud and roots is shown in Fig. 2. Fig. 3 is from the tip of a shoot, and Fig. 4 is a single-eye cutting.

BUDDING THE FIG.—The foregoing means enable one to propagate a fig so rapidly that recourse is not had to budding, as in propagating other trees; still, budding is feasible, either on small plants or on young shoots of old trees which it is desired to work over.

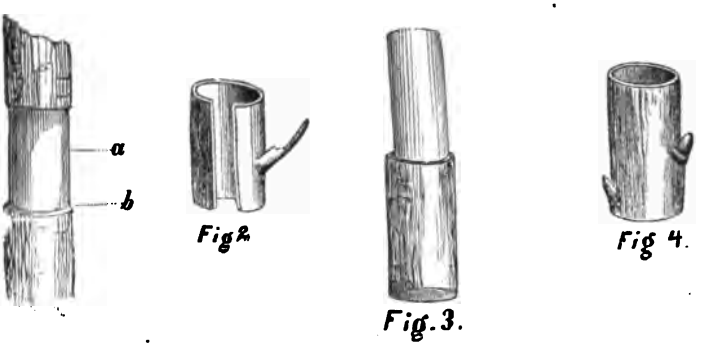
The fig may be budded by the common shield method, as used for ordinary fruit trees, and described on page 110, but, owing to the tendency of the fig bark to shrink in drying, the bud should be closely bound in with a narrow waxed band (see page 114), to exclude the air. As the bark is thick, it is often desirable to cut out a little of the edges closest to the bud when in place.

A better method of budding the fig is by annular or "ring budding," a method also relied upon with the walnut and chestnut.* Annular budding, as shown in Figs. 1 and 2, is done in the fall. A circular ring of bark is taken off from the stock, as shown in the first figure on the left, which operation is done by the aid of a budding knife, by running two circular cuts around the stock, and a longitudinal one between the two circular cuts, the ring of bark taken off having the appearance shown in Fig. 2. This ring must be at least one inch wide, and from that up to two inches. A like ring of bark is taken off in the same manner from a scion of the variety to be budded in, and from a branch of the year, or preceding one, well in sap, and having about the same diameter as the stock. This ring should have on it one or two buds. It must fit exactly the space (*a*) seen on Fig. 1, and more particularly at the lower circular cut (*b*), so that both barks will exactly unite at that point. When the ring is too long, a little bit of it might be cut off with a very sharp knife till it fits well; if the ring is too large for the stock, a longitudinal strip would be cut out, and if too narrow, such a strip, if with a bud on so much the better, will have to be used to fill up the empty space. One must be very careful while drawing the knife around the stock not to go too deep into the wood to injure the cambium layer, or to weaken the stock. Tie

*Felix Gillet, Nevada City, in *Rural Press*.

a bandage pretty firmly over the whole. After two or three weeks the bandage has to be taken off, and, in the ensuing spring, the top of the stock or limb is cut down three inches above the budding.

Another way of working such trees is by "whistle budding," which is done *in the spring*, when the sap is well up. Figs. 3 and 4 show this method. The stock and scion must be both of the same size and well in sap. The top of the stock is cut down to several inches from the ground; a circular ring of bark is then taken off, and a corresponding ring from the scion, but without



ANNULAR AND WHISTLE BUDDING ILLUSTRATED.

a longitudinal cut, is put in its place. In inserting it care should be taken that the top of the stock, which is to receive the ring from the scion, be very smooth, and the latter is then easily pushed down around it and bandaged. In the case of the fig, it is especially desirable to use the latter method when the sap is up, because if the top of the stock is not removed, the exudation from above sours around the bud and prevents the union of bud and stock.*

To prepare an old fig tree for budding over, the limbs may be cut back in February within two to six feet of the trunk, covering the ends with shellac or grafting wax. Allow two shoots to start near the end of each of these amputated limbs, and rub off all other shoots. Bud the shoots when they attain the thickness of one's finger, taking green buds from the growth it is desired to introduce, or let them grow and bud in the fall, whichever is most convenient; or bud in the growing shoot, and rebud in the fall where buds have failed.

GRAFTING THE FIG.—The fig can be grafted by the cleft-graft method, as described on page 121. Especial care must be

*W. W. Smith, Vacaville, at Los Angeles Convention, 1885.

taken, however, in excluding the air. Mr. A. M. Gass, of San Diego, reports success by filling the cleft between the scions with hot wax, which will run in and fill the cavity. Then he binds the stock with wax bands, taking the greatest care to cover the exposed wood surface, the cut end of the bark (which in the fig is very prone to shrink and draw back), and as far down the stock as the bark has been split. He has best success with grafting in February.

Objection is made to both budded and grafted fig trees because of their disposition to sucker incessantly.

SEEDLING FIGS.—Figs are readily grown from the imported fig of commerce, and the growth of seedlings began very early in this State, for it is recorded that Major Reading had a seedling fig tree in bearing in 1858, bearing "figs of uncommon size."* Dr. Gustav Eisen, of San Francisco, our leading writer on the fig, gives the following explicit directions for growing the fig from seed:—

> Cut open imported Smyrna figs; wash out the seeds in warm water; those that float are empty and worthless; those that sink are generally fertile. Sow these in shallow boxes of sand and loam mixed, and place in a frame under glass. In three weeks they will be up and must be very sparingly watered. Set out next season in nursery row. In three years from the seed such plants will be found to bear. Do not throw away plants until six to eight years old, as some may develop, or show their qualities late.†

Dr. Eisen states that California figs, as now grown, do not contain fertile seeds; also, that the tendency of the plants grown from Smyrna figs is to revert to the wild type; still there is a chance of securing good varieties, and the effort is commended to horticultural experimenters. Mr. E. W. Maslin, of San Francisco, has a large number of seedlings of the Smyrna fig now on trial on his farm in Placer County.

PLANTING AND PRUNING THE FIG.

The chief point to observe in planting fig trees is to get them far enough apart, because of the great spread of branches which they attain. Of course they may be planted twenty feet apart if the owner intends to remove alternate rows, but to plant at forty feet, or even farther apart, with other fruit trees or vines between, on the plan of alternate or double squares, described on page 126. would be the best way to lay out a fig orchard—the intermediate growths to be removed as the figs require more room. Mr. Williamson's advice is for rather closer planting, as follows:—

*Agricultural Society Report, 1858, p. 223.

†"The Fig of Commerce: Its Culture and Curing," and a descriptive catalogue of all its known varieties. By Gustav Eisen, *Rural Californian*, Los Angeles, 1888.

The fig is a long-lived and strong-growing tree, and the trees should be planted farther apart than most other fruit trees, especially the stronger-growing kinds, such as the Large Purple, Pacific White, and White Adriatic. The San Pedro and White Ischia are not strong growers, and consequently might be planted closer, but even they want plenty of room. I would recommend planting fig trees from twenty-six to thirty two feet apart. Then fill in with grape-vines, berries, or some other fruit trees, such as peaches, plums, prunes, or quinces—something that can be taken out at the end of ten or twelve years, or so soon as the fig trees need all the room. Thus a quick and constant return can be realized from all the land. The fig and grape do well together, and I should prefer filling it with grapes to anything else, if the land is well adapted to grape growing. The vines can remain in the fig orchard fully as long, if not longer, than most anything else; but I would not plant them too close to the tree. Then, in thinning out, take out those nearest the trees first; they need not all be taken out at once.

Very handsome effects are produced by planting the fig along avenues to inclose orchards of other fruits.

In transplanting fig trees extra care must be taken to keep the roots from drying. After planting, the stem must be diligently guarded from sunburn, to which it is liable in the warmer parts of the State. The ways described on page 150 are available for this purpose.

PRUNING THE FIG.—The fig requires very little pruning after its shape is outlined. There is difference of opinion and practice as to the height at which the head should be formed; some head as low as already advised for common orchard trees; others, having in mind the immense thickness attained by the limbs, and their disposition to droop, head as high as four to six feet. Dr. Eisen advises low heading of trees grown for table figs, which must be picked, and high heading of trees grown for drying, so that access can be had to all parts of the ground for clearing up rubbish, and for gathering the fallen fruit from the smoothed ground. No fixed rules can be derived from California practice, except that figs are generally headed somewhat higher than other trees.

In shaping the tree, branches should be brought out at a distance apart on the stem, so that there may be room for their expansion without crowding each other, and care should be taken not to leave too many main limbs. Three limbs, well placed around the stem, are enough. The branches putting out on the under side of these limbs should be suppressed, and those growing upright, or obliquely upright, retained. After getting the general shape of the tree fixed, there is little need of pruning except to remove branches which will cross and interfere with each other, etc.

CULTIVATION.—Young fig orchards are cultivated as are other fruit areas. Old trees which completely shade the ground are usually left to themselves, without cultivation, except cut-

ting out weeds. Irrigation is governed by local conditions, as already stated.

BEARING AGE OF THE FIG.

The fig often, and, perhaps, usually, begins its bearing very early, in the most favorable situations in this State. Some fruit is often had the second year, and a crop worth handling the third year. Still, it is wiser not to calculate definitely upon such returns, for four or five years sometimes pass without a satisfactory crop. We have, also, instances of "barren fig trees," which persist in "dropping their untimely figs," year after year, during their youth. How much of this is due to variety, and how much to locality, is not definitely known, but successful fruiting has been secured by grafting over barren trees, using scions from bearing trees growing adjacent to them.

CAPRIFICATION.—The fine arts of fig growing, as practiced abroad, have, as yet, but little place in Californian practice. Caprification, which consists of suspending the fruit of the wild or *capri* fig in the branches of the tree of improved variety, that the pollen may be carried by an insect from the former to the latter, has been fully discussed in this State in the light of European researches, but has not been reduced to practical demonstration, nor is it known that we have the insect needed for the work.

The first caprification on record in California was accomplished by Geo. C. Roeding, manager of the Fancher Creek Nursery, in 1890. He procured cuttings from Smyrna in 1887 which proved to be both those of the edible fig and of the *capri* or wild fig. In 1889 the former bore fruit, but the fruit dropped prematurely. In 1890 Mr. Roeding opened some of the *capri* figs, secured the pollen on the end of a toothpick, and introduced this implement as far as he could, without injury to the fruit, into some of the figs on a Smyrna tree. Subsequent examination showed that every fig fertilized matured good Smyrna figs, full of developed seed, and richly flavored. The figs on the tree which were not thus fertilized failed to mature. Of course fertilizing figs by hand is not practicable except in an experimental way, and the next step in demonstration of caprification will be to secure the insect which is credited with the work abroad.

The means of securing early ripening of the fruit by injecting a drop of oil in the eye of the fruit has not been practiced to any extent, nor does it appear that our markets would repay the effort.

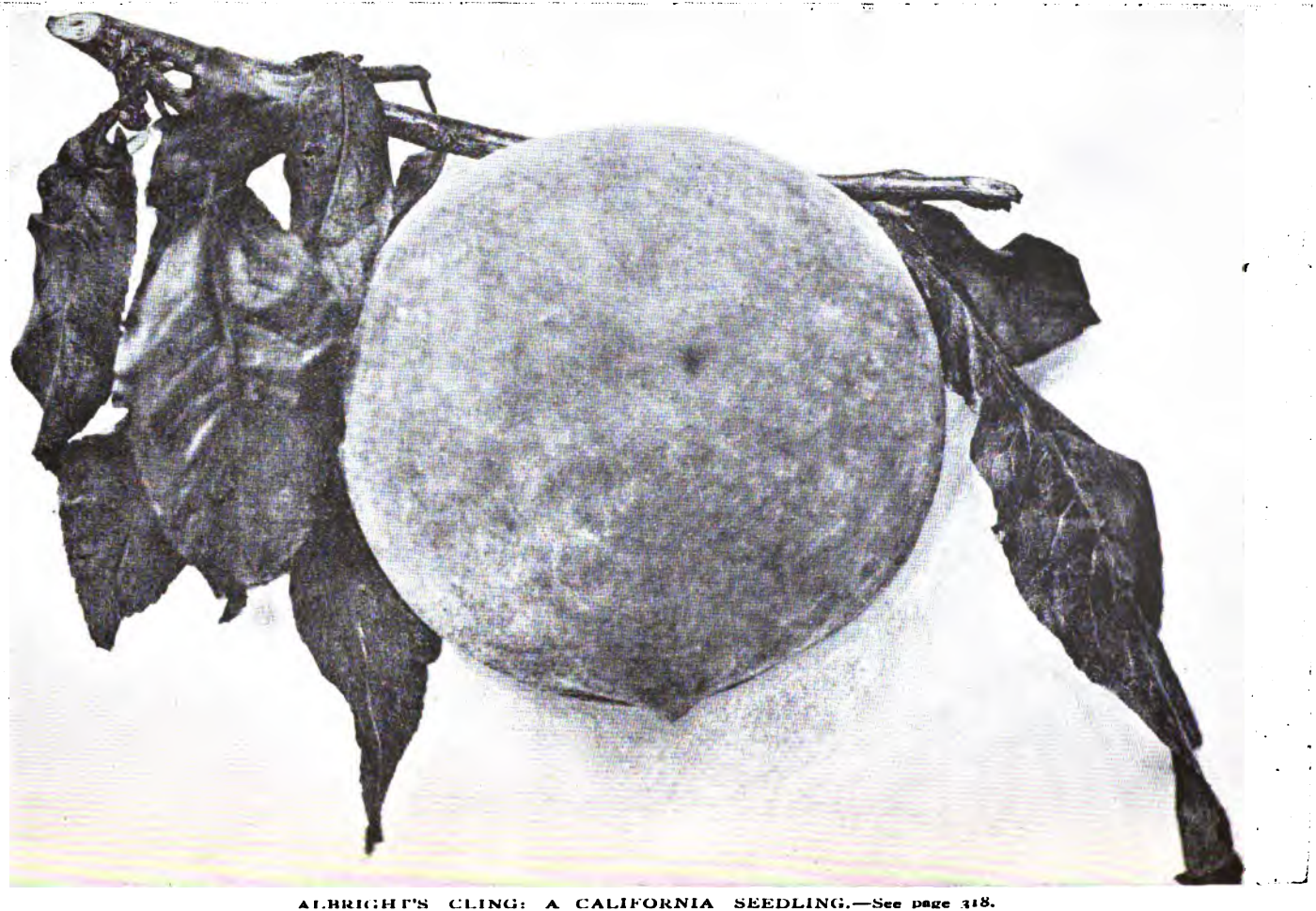
FOES OF THE FIG.—The fig is freer from insect pests than other fruit trees, and yet it is a mistake to consider it wholly free. The writer has seen the leaves well covered with a *lecanium* scale, and has found a moth larva boring in the pith of the young shoots; still, practically, the fig tree in California has not yet suffered from insects.

The gopher has a pronounced appetite for fig roots, and their presence should be carefully watched for. Swine have a liking for fig bark. The trees of the grand grove planted at Hock Farm, on the Feather River, by General Sutter, were completely girdled from the ground as high as a pig could reach by standing on its hind legs. Figs make good food for hogs, and plantations have been made with this in view, but if the hogs are to be harvesters, it will be well to protect the stems of the trees from them.

VARIETIES OF THE FIG.

The fig presents what may be termed an aggravated example of the confused nomenclature which pervades California fruits. Dr. Eisen has made a commendable effort, to which reference has already been made, to bring order out of chaos by a study of foreign records and locally-grown fruit, and has published a catalogue of all known varieties, with descriptions of the characteristics of each. Ever since the introduction of improved fruits began, European fig varieties have been brought here by immigrants from fig countries and by Americans who have visited these regions. These varieties bearing local names have been almost inextricably confused by distribution in this State. There have also been many special efforts made to secure the true Smyrna fig, from the fruit of which the fine white figs of commerce are prepared, and it is believed that this variety has been obtained. Recently there have been large collections of foreign varieties, true to name, imported, as, for example, the introduction by John Rock, of San Jose, which includes the varieties described by Hogg. Trees of this importation have been planted at the University Agricultural Experiment Stations in Amador, Tulare, and San Luis Obispo Counties, and will serve erelong as a source whence cuttings true to name can be obtained.

The following is a condensed compilation from the writings of Dr. Eisen and others, descriptive of the varieties now chiefly grown in this State; it must be borne in mind, however, that local conditions have much to do with modifying what may be called the plastic elements in the formation of the fruit, such as color, thickness, and texture of skin, etc., and therefore the de-



ALBRIGHT'S CLING: A CALIFORNIA SEEDLING.—See page 318.

scriptions given may not be accurate for all localities. Possibly a later revision may take cognizance of these local variations:—

BROWN TURKEY.—"Fruit large, pyriform; skin brownish red, with blue bloom, thick; pulp sweet and good, of no color; a very prolific and hardy variety."—Dr. Eisen. The earliest fig in the San Francisco market.

BRUNSWICK.—"Fruit very large, pyriform, oblique at the apex, which is much depressed; skin greenish yellow in the shade pale brown in the sun; very hardy, but bearing qualities medium to poor."—Dr. Eisen. "After careful comparison and thorough investigation, we have come to the conclusion that this is the same fig which has been sold here for many years as the Smyrna. After the California black, it is the best adapted for general cultivation."—John Rock.

CALIFORNIA BLACK; syn. Mission fig.—The most widely-grown variety, until recent additions of fine white sorts; large, dark purple, very productive and hardy. "It has many qualities that commend it; when properly cured is delicious, and, in the opinion of many, equal to the imported Smyrna. Its color alone prevents it from being a favorite in the market, and still, with an inferior price, its unusual productiveness renders it profitable."—W. B. West.

BROWN ISCHIA.—"Fruit medium, roundish turbinate; skin light brown, or chestnut colored, bursts easily after showers of rain; eye very large; pulp sweet and tolerably well flavored, and of deep purple color; tree hardy, a good grower and bearer."—Dr. Eisen.

WHITE ISCHIA —"Fruit small, turbinate; skin very thin, greenish yellow with brownish shade from the inside; purple meat, rich, but with little flavor; tree with round, deeply-lobed leaves; round head; a good grower and bearer."—Dr. Eisen.

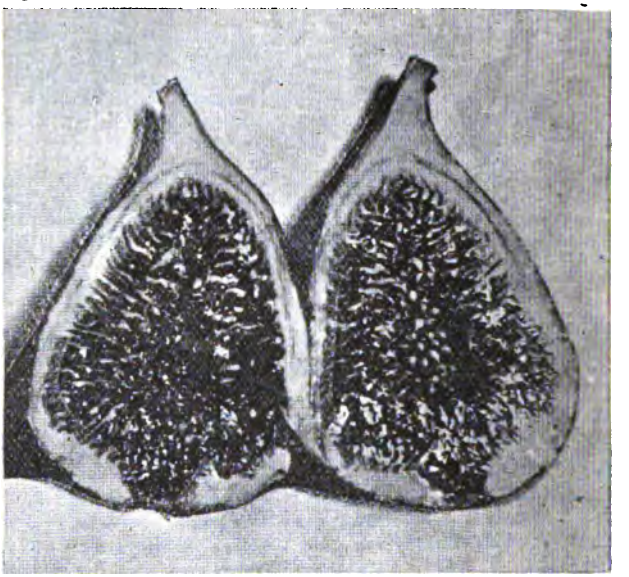
GROSSE MARSEILLAISE; syn. White Marseillaise, White Genoa, etc.—"Fruit above medium, quite round, with short neck; skin bright yellow, with bright spots; ribs well marked longitudinally; pulp full, sugary, juicy; good for table and drying."—Dr. Eisen.

MARSEILLAISE; syn Petite Marseillaise, Burnham's Smyrna.—"Fruit medium to small, roundish turbinate; skin greenish yellow, no bloom; ribs distinct even to the stalk; pulp rose-colored in the center, opaline toward the stalk; very sugary and sweet, but not high-flavored; good for drying; inferior to Grosse Marseillaise in size and flavor, but less tender."—Dr. Eisen.

SAN PEDRO.—"Large, upright-growing tree; leaves woolly, dark green; fruit large (three to four inches in diameter), shape nearly round and somewhat flattened; skin greenish yellow, bright deep yellow in the sun, no bloom, thick but very tender; eye very large, open; pulp light amber opaline, with traces of rose; coarse but sweet."—Dr. Eisen.

WHITE ADRIATIC.—This variety is at present the most widely distributed white fig in California. Dr. Eisen gives the following interesting account of its introduction and distribution: "The true name of this fig is *Fico di Fragola*, or strawberry fig. The name Verdoni was given by W. B. West, who recognized the tree under that name in Italy. The name White Adriatic was invented by the late G. N. Milco. The fig has been at least twice imported from Italy to California, the first time by an Italian, who sold the trees to W. B. West and G. N. Milco, of Stockton, many (ten to twenty) years ago. Messrs. G. N. Milco, W. C. West, W. M. Williams, and Gustav Eison were the first to discover its superior qualities, and to propagate and distribute it extensively. The fig is proving one of the finest grown." W. B. West writes: "Trees of this variety are growing at Knight's Ferry, Stanislaus County, that were planted twenty years ago. It is a strong-growing, hardy kind, and will bear a crop where most of the tender kinds will not." The fruit, as grown in San Joaquin Valley, is described by Dr. Eisen as follows: "Medium or above medium size,

rounded pyriform, with medium neck, but short stalk; skin greenish in the shade, turning to bright greenish yellow in the sun; ribs rather obscure; eye open, with red iris; pulp bright strawberry red, drying to a rather pale yellow; skin very thin, and, together with the pulp, forms a most delicious aromatic sweetmeat when grown in favorable places."



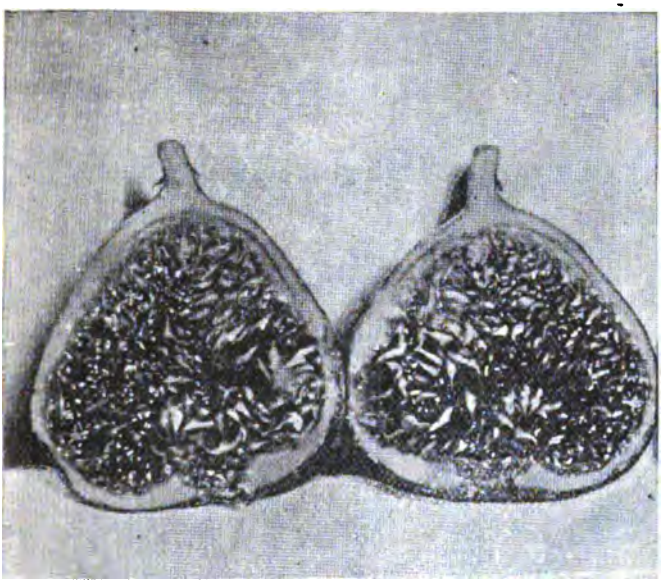
THE WHITE ADRIATIC FIG.

BULLETIN SMYRNA.—Of several attempts to secure the true Smyrna fig, or the variety which produces the well-known Smyrna fig of commerce, that made by the San Francisco *Bulletin*, and managed by G. P. Rixford, has achieved most prominence, and is now generally conceded to have proved successful. Fourteen thousand cuttings were obtained through United States Consul E. J. Smithers, in 1882, and a large part of these were distributed throughout the State. As the trees came into bearing there was much complaint of dropping fruit, but in a few places, at least, the fruit has matured, and samples of the dried figs shown by H. E. Parker, of Penryn, Placer County, at the Fruit Growers' Convention at Chico, November, 1888, and pronounced by a committee consisting of W. W. Smith, F. A. Kimball and G. M. Gray, superior to the imported Smyrna figs, and to the White Adriatic grown in this State.

The accompanying engravings show the White Adriatic, grown by the California Nursery at Niles, Alameda County, and the Bulletin Smyrna, grown by Mr. Parker, at Penryn, Placer County. The prevailing opinion is that the fig grown by Mr. Parker is the White Adriatic, but some hold it to be another variety. However this may be determined, the difference in form evidently is not a distinguishing characteristic, because as great variation is frequently seen in fruit from the same tree.

A later direct importation of fig cuttings from Smyrna was made by W. C. West, for F. Roeding, proprietor of the Fancher Creek Nursery of Fresno. These trees have already borne fruit, as has been described in a preceding paragraph on caprification. In the summer of 1890 cuttings imported from Smyrna by the United States Department of Agriculture were sent to several parties in this State.

PACIFIC WHITE.—An unknown variety found growing on a farm in Placer County, named and propagated by W. R. Strong & Co., of Sacramento, who describe it: "Medium size, fine-grained, very sweet; dries well, but the skin is thicker and more tough than the imported fig. That and its small size are the only objections to it."



THE "BULLETIN SMYRNA" FIG, AS GROWN BY MR. PARKER.

There are many undetermined varieties of the fig grown here and there in the State. Some may be finally identified, others may be new. Some of them yield an excellent dried fruit and should be more carefully experimented with. As an illustration of these stray varieties may be mentioned one being propagated by J. P. Onstatt, of Sutter County—a good-s zed fig of light yellowish-green color, thin skin, flesh very sweet and full of seeds, and dries a light color without sulphur.

There is now a wide disposition to study closely and experiment carefully with the fig, and the possibility of vastly extending the fig interest of the State is clearly foreseen. A few years' more effort will no doubt greatly extend our knowledge of the fruit and our skill in its growth and preparation for market.

CHAPTER XXX.

THE OLIVE.

THE olive is another of the old mission fruits which has recently risen to a high place in the public mind. Though the tree and its products have been constantly under discussion since the American occupation, and though experimentation has been constant, it is only within a very few years that the tide of popular favor has turned strongly toward the olive. Probably the present disposition to investment in olive plantations for oil is due more to the successful enterprise of Ellwood Cooper, of Santa Barbara, than to any other single influence. Mr. Cooper's faith in the olive exhibited itself several years ago in the generous outlay he made to secure the information and outfit required for oil making. He made a devoted personal study of the enterprise, and receives his reward in the form of excellent prices for his product, and the consciousness of having done well for the State. There seems at present some danger that the price at which Mr. Cooper and other early olive planters have attained success may be overlooked. It is true that the advice which they generously give will guard new planters against mistakes, and save them much labor and expense in inquiry and experiment, and yet it should not be forgotten that the preparation of olive products is one of the higher arts of manufacturing, and nothing short of patient and persistent personal

THE OLIVE IN BLOOM AND IN FRUIT.

effort will win success. Though the enterprising pioneers in olive culture have opened the way, it cannot be followed with closed eyes. Some persons, either through ignorance, or through interest in the sale of plants or lands, seem disposed to give the inexperienced planter the idea that olive oil is as easily and quickly made as cider, and that pickling olives is not more difficult than salting cucumbers. The future is full of promise, but probably only those who are willing to labor and to wait will succeed in olive products. It will require several years to determine the commercial features of the industry on the basis of a large product, but the data will be forthcoming, because the area of young olive trees is now large, and is being rapidly extended.

Olive oil has, unfortunately, to contend with almost limitless adulteration and the sale of baser oils as substitutes—in both cases in the name of the pure product of the olive. Such adulteration is now rife both in this country and Europe, and has been largely practiced even in our own State, where fancy labels bearing names of olive farms which do not exist have been used. The California Legislature in 1891 passed a law that all manufacturers of olive oil shall use labels stating clearly name and location of manufacture, and shall file a copy of the label with the State Board of Horticulture. The law also prescribes penalties for adulteration of olive oil in the State. After the passage of the law, an association of California olive oil producers was formed to promote the interests of the pure product.

One indication of the popularity of the olive may be found in the amount of local literature* devoted to the methods of its culture and the profits to be derived therefrom. There has been more published on the olive than on any other single fruit grown in California, except, perhaps, the grape, and yet the present value of the olive product is small as compared with that of other fruits. Because of the amount of information available, and, in the case

*The olive literature of California includes the following:—

Redding, B B. "The Olive in California." California Acad. of Sciences, Feb., 1878.

Bleasdale, J. I. "The Olive Tree and Its Products, and the Suitability of the Soil and Climate of California for Its Extensive and Profitable Cultivation." Dewey & Co., San Francisco, 1881.

Cooper, Ellwood. "Olive Culture in California." Santa Barbara, 1882 (republished in report California State Agricultural Society, 1887), also later essays in Reports State Board of Horticulture, 1886 and 1888.

Klee, W. G. "The Olive." State University Bulletin 41, 1885, and revised in University Report, 1887; also Bulletin 85 "Observations on Olive Varieties." Feb., 1890.

Pohndorff. F. "A Memoir on Olive Growing," 1884; republished in Report State Board Horticulture, 1886.

Flamant, A. "A Practical Treatise on Olive Culture," etc. Louis Gregoire & Co., San Francisco, 1887.

Marvin, A. T. "The Olive: Its Culture, in Theory and Practice." Payot, Upham & Co., San Francisco 1888.

Lelong, B. M. "The Olive in California: Varieties, Budding, Grafting, and General Observations." Special publication by State Board of Horticulture, 1888; also Reports of 1889 and 1890.

Paparelli, L. "Notes on California Olives: Their Adaptations and Oils." State University Bulletin 92, March, 1891.

of the publications of the State Board of Horticulture and the State University, to be had for the asking, it is thought best to restrict the treatment of the olive in this connection, in the main, to useful suggestions on culture as practiced in this State. Several of the works already cited indulge freely in discussion of analogies between California and European conditions and practices, and are useful in that they save the general reader from researches in foreign tongues.

CLIMATE, SITUATION, AND SOIL.

Mr. Redding, in his paper on the olive, cites many foreign authorities to show that the temperature to favor the olive must be a mean annual not below 57°; the mean for the coldest month must be as warm as 41°, and at no time must the temperature fall below 14°. The consideration of these requirements in connection with the characteristics of the California climate, as sketched in Chapters I and II of this book, will show how wide an area of the State is theoretically suited for the olive.

During the last few years testimony from actual growth has accumulated, showing that the tree will thrive throughout the larger part of California, and it has been shown that it will grow in a soil too dry even for the grapevine, and too rocky for any fruit tree. The hills and mountain slopes, not fit for the pasture of even a goat, can be made to produce olives. In such situations the trees bear fruit earlier than in the rich valleys, although in the latter the trees attain larger growth. Trees in the interior bear sooner than on the coast, and ripen their fruit earlier in the season. We have almost everything to learn of the adaptation of varieties to the different situations, but data of this kind will soon be available through the many importations of the best foreign varieties which have been made by different parties during the last few years.

The olive tree is now thriving in California in a great variety of soils. The chief requisites seem to be warmth and good drainage. On low, moist lands it has made but indifferent growth, while on hillsides, even where excavations had to be made between bowlders, or into disintegrating rock, the tree has exhibited thrift and content with the situation. But the conclusion should not be drawn that the olive needs poor soil. It may thrive with loose rock or bowlders, but it finds among them the elements it needs. It is not to be inferred that the olive will succeed on sterile soil.

We have not had experience enough in this State to demonstrate the influence of soils on the quality of the oil, but oil thought to be good has been made from fruit grown on some of

our best valley fruit soils, deep and naturally well drained, as, for example, on Putah Creek, where the tree is said to have attained a girth of six feet at twenty years from the cutting.

At present olive planting is proceeding on all kinds of land and in all situations. From these plantations our children may gain wisdom.

PROPAGATION OF THE OLIVE.

Olives are propagated from seed, and from cuttings of various kinds and sizes. The growth from seed is seldom practiced in this State, probably for two reasons: First, because the Mission olive, which is the only kind that has fruited in this State until very recently, produces a small percentage of pits containing kernels capable of germination. Second, the growth from cuttings is easy, and furnishes the variety desired without grafting. Whether we shall, by growing other varieties, or the same variety in other localities, secure fertile seeds and use them for propagation, as they do in Europe, the future must determine. It would certainly seem that for planting in dry, rocky situations, the seedling root would be preferable.

GROWING OLIVES FROM SEED.—W. G. Klee gives the following results of his experience with pits while in charge of the University propagating houses at Berkeley:—

The olives should not be planted with the pulp, but must be cleaned of this either by letting them rot in a pile or by putting them into an alkaline solution to cut the oil. A simple way to hasten germination is to break the pits, taking care not to hurt the germ. An instrument similar to the nut cracker has been invented in France which is said to work very well. When the kernels are deprived of their shell, they are steeped in a compost, or mixture of cow-dung and sandy soil, and are sown thickly in the month of April. If it is thought to be too much work to take the kernel out of the pit, they must be soaked in an alkaline solution. We used a solution of one-fourth pound of concentrated lye to the gallon of water. Most of the seeds sprouted the first year, although there were a few stragglers produced the next year. Planting the naked kernels gives the quickest result. Without using this artificial means the seeds will remain dormant at least for two years.

Dr. F. S. Gould, of Santa Barbara, succeeds with the use of a small bench vice for cracking the pits, thereby securing about six hundred clean kernels per day, and prefers this to the use of lye.*

LARGE CUTTINGS.—There are two chief methods of propagating the olives from cuttings now practiced in California. One uses well-matured wood, and the other young wood which has just passed out of the herbaceous state. Practice with hard wood proceeds, in the main, according to the method employed by Ellwood Cooper, and which he describes as follows:—

*Vide Report State Board Horticulture, 1883, p. 78.

The common and preferred method is to plant the cuttings taken from trees of sound wood, from three-quarters of an inch to an inch and a half in diameter, and from fourteen to sixteen inches long. These cuttings should be taken from the tree during the months of December and January, neatly trimmed without bruising, and carefully trenched in loose, sandy soil. A shady place is preferred. They should be planted in permanent sites from February 20 to March 20, depending upon the season. The ground should be well prepared and sufficiently dry so that there is no mud, and the weather should be warm. In Santa Barbara, near the coast, no irrigation is necessary; but very frequent stirring of the top soil with a hoe or iron rake

PROPAGATING THE OLIVE BY SMALL CUTTINGS.

for a considerable distance around the cuttings is necessary during the spring and summer. About three-fourths of all that are well planted will grow. My plan is to set them twenty feet apart each way, and place them in the ground butt end down, and at an angle of about forty-five degrees, the top to the north, barely covered. Mark the place with a stake. By planting them obliquely the bottom end will be from ten inches to one foot below the surface.

This method is largely used with the Mission variety, of which there is plenty of old wood available. The objection to

it is that the large cuttings sometimes remain dormant for a year or more, and thus gaps are made in the plantation. It is Mr. Cooper's practice, however, to start some large cuttings in nursery at the same time that he puts others in permanent place, and he transplants from nursery to fill vacancies even after the nursery trees attain considerable size, and they are transplanted readily if the top is properly reduced. Mr. Cooper removes all the lateral branches when transplanting. Planting out large cuttings in nursery is done as is described in a previous chapter for rooting vine cuttings.

SMALL CUTTINGS.—Propagating by small cuttings has increased rapidly during the last few years. It serves an excellent purpose in rapid multiplication of the new varieties which are being secured from abroad; it enables the grower to handle a large number of plants in a small space, and the plants from small cuttings have a symmetrical root system quite resembling that from a seed. These cuttings are made from very small shoots and both the tips and the lower cuts are used. The engravings show small cuttings made by Kenneth McLennan while foreman of the University propagating grounds at Berkeley; the figure on the left is a tip cutting; the next, a cutting lower down the shoot, and the figure on the right is a tip cutting as lifted from the sand to show its manner of rooting. These figures are about natural size, and show clearly how the cuttings are made. They are placed closely in boxes of sand about four inches deep, and after a few months are potted in small pots, or may be reset farther apart in boxes of soil or in the open ground. If the cuttings are made in January or February, when the wood seems to be in the best condition in Berkeley, the trees will be of good size for planting in permanent place the next winter. There is much difference in the success of different varieties in growth, from small cuttings. The Redding Picholine roots very readily, and so do many of the new varieties recently imported. The Mission shows a small percentage of success. It is very important to take the small cuttings just when the wood is in the right condition, not too soft nor too hard. How to determine this point cannot be described; it must be learned by experience.

GROWING TREES FROM TRUNCHEONS.—New varieties secured from the south of Europe generally come in the shape of truncheons, which are long sticks of hard wood. They may be planted entire, or be sawn and split into large cuttings (for olive cuttings, even in firewood shape, will grow if properly treated),

but the varieties can be most rapidly multiplied by treating the truncheons as described by Mr. Klee, as follows:—

Cut the truncheons in pieces about eighteen inches long, split those pieces in two, put the halves so made into the ground horizontally, with the bark side up, covering with soil four or five inches deep. Let such bed be in a warm, well-drained place, kept moderately moist. In a few months a large number of young shoots will break through the ground. When of suitable size and hardness for small cuttings, work up these shoots by that method.

BUDDING THE OLIVE.

Since a large area of Redding Picholines has been planted, and the fruit found different from that anticipated, and as there may be

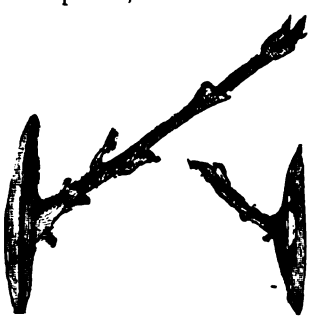


FIG. 1. TWIG BUDS.

other demands for changing over trees into improved varieties, much interest has arisen in budding and grafting the olive. Mr. Lelong has rendered timely service by expounding this subject in his treatise, and the writer is indebted to him for the illustrations and descriptions used herewith.

BUDDING THE OLIVE.—The method of budding commonly employed with fruit trees does not usually yield a high percentage of success with the olive, and other ways have been adopted with much better results.

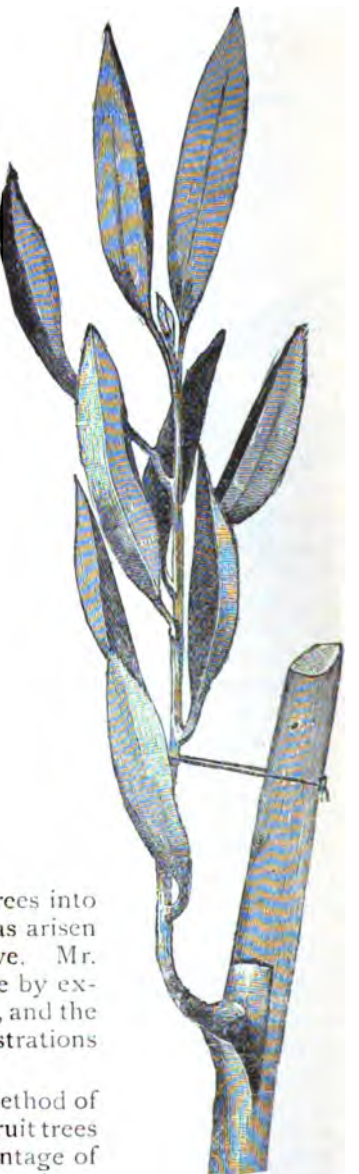


FIG. 2. GROWTH OF A TWIG BUD.

Budding may be performed at any time of the year when

the sap flows freely. If done late in the summer, the buds lie dormant through the winter. Best results are obtained when the buds are inserted early in the spring, as the operation can be performed to a much better advantage, and the buds will grow to some height before winter. When inserted in large orchard trees, or in limbs of large trees, the shoots from the inserted buds are allowed to grow until they have attained such a size as will justify in the removal of the entire top.

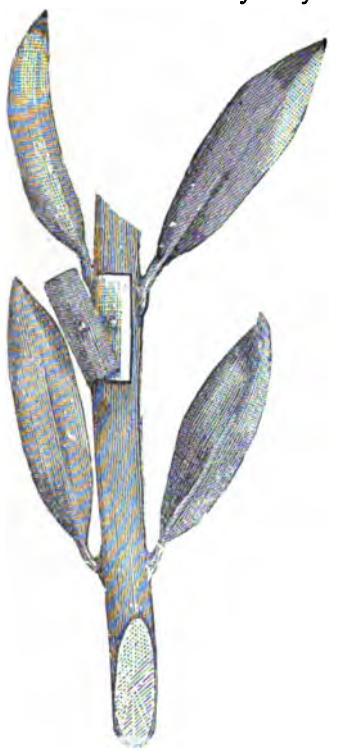


FIG. 3. REMOVING A PLATE BUD.

TWIG BUDDING.—The bud is cut deep into the wood, in order to give the bud as much bark as possible. The leaves are partly cut off, then, with the sharp point of the budding knife; the greatest part of the wood inside of the bud is removed, as shown in Fig. 1, which shows large and small twig buds. If part of the wood is not removed, then the bud cannot take, as the wood in it prevents the two barks (the inner bark of the bud and the inner bark of the stock) from uniting. When the wood has been partly removed from the bud, the bud is inserted into the stock, as budding is done in the regular ordinary way, and tied tight. At the end of three weeks the string is removed and part of the top of the stalk is cut back to force the bud to start. As the bud grows, the foliage of the stalk is gradually removed, until the bud is able to take up the entire flow of sap; it is then left to grow, and trained as shown in Fig. 2, which also shows the manner of inserting the bud in the stock. When the bud has grown out strongly, what remains of the stock above the bud is cut smooth, close to the bud, to allow it to heal over.

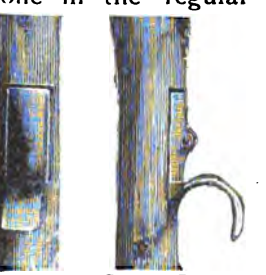


FIG. 4. PLATE BUD IN PLACE.

PLATE BUDDING.—An ingenious method of plate budding, or inlaying, has been successfully followed by Charles A. Wetmore,

of Livermore. In this method the bud is removed, as shown in Fig. 3. The leaf is cut off close to the bud, then the bud is removed, as shown in the illustration (the buds do not grow where the bud is removed, as shown in Fig. 3; this is only intended to show how the buds are removed from the scion). A cut is made in the stock of proper size to receive the bud, but the lower edge is not cut, but the flap of bark is turned down, and the bud inserted, as shown in Fig. 4, which gives front and side views of the bud in place. It does not matter if the buds do not fit (the bud should always be a little smaller than the space in which it is inserted). This being done, the flap of bark is turned up, covering the bud entirely; then it is tied tight with heavy twine. The twine for this purpose should not be less than eighteen ply. The success of the operation lies in the tying. If it should not be tied tight, the bud will surely die. Mr. Wetmore found that the best way was to throw the twine in water, and tie it while wet. After the bud has been inserted two weeks, the string is removed, and a week or so after that, the tree is girdled above the bud to force it to start. This girdling consists of a ring of bark being removed from the stalk, being cut an inch or so above the bud. Care should be taken not to injure (by scraping) the wood after the ring is removed, as this would kill the inner bark, and cause the tree to die back before

FIG. 6. BUD COVERED WITH TWO FLAPS.

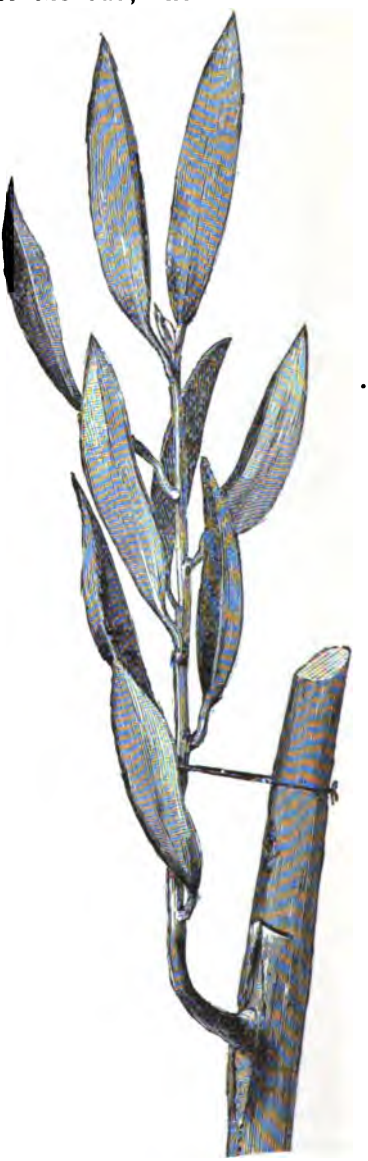


FIG 5. GROWTH ON A PLATE BUD.

the bud has had a chance to start. After the bud has started, it is trained to the stalk, and left to grow until large enough to justify the removing of the entire top, and allow the bud to become the tree. Fig. 5 shows the growth on a plate bud inserted and trained as described.

An improved method of inserting the plate bud is also followed by Mr. Wetmore. It consists in making a cut into the bark of the stalk in the form of the letter **H**. The bark is then turned up and down, the bud inserted, and then turning the bark down above and below protects both ends of the inserted plate, while the previous method leaves the top edge uncovered. Mr. Wetmore prefers this method, as it also admits of the use of buds with a bulge at the attachment of the old leaf, which the former method does not. This manner of inserting a bud is shown in Fig. 6.

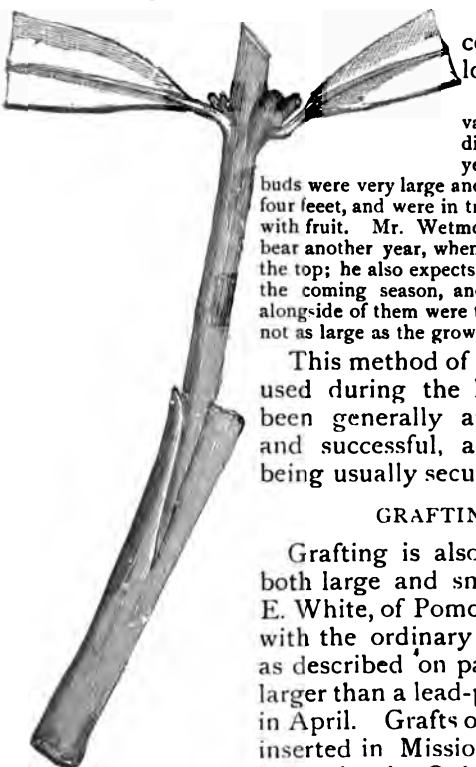


FIG. 7. CLEFT GRAFT FOR SMALL WOOD.

Of Mr. Wetmore's success in budding, Mr. Lelong writes:—

> I saw trees of nearly every size, varying from one to six inches in diameter, that had been budded a year and two years. Some of the buds were very large and had grown to a height of about four feeet, and were in trees that at the time were loaded with fruit. Mr. Wetmore intends to allow his trees to bear another year, when the buds will take the place of the top; he also expects some of these buds to bear fruit the coming season, and I believe they will, because alongside of them were trees loaded with fruit that were not as large as the growth of the buds.

This method of budding has been widely used during the last two years, and has been generally approved as expeditious and successful, a very high percentage being usually secured.

GRAFTING THE OLIVE.

Grafting is also used in working over both large and small olive trees. Mr. C. E. White, of Pomona, has had good success with the ordinary method of top-grafting, as described on page 121, using scions not larger than a lead-pencil and inserting them in April. Grafts of Redding Picholine thus inserted in Mission trees are now in bearing. At the Quito Olive Farm, in Santa Clara County, many old trees have been worked over by this method. The olive can also be successfully

grafted in the bark according to the method shown on page 122. This graft is often made at the surface of the ground, covering the cut surfaces with earth when the scions are in place.

CLEFT GRAFT ON SMALL WOOD.—Fig. 7 shows a cleft graft made with an oblique cut, which is superior to a split of the stock, because on a small stock the split is apt to continue farther than desirable when the scion is pushed in. With the slanting cut in the stock the scion can be firmly pushed into place without splitting. The union of inner barks of scion and stock must be made on one side when the stock is larger than the scion. This graft is tied in and waxed, or a waxed band may be used. In working small wood at the ground surface, the earth should be drawn up around the graft. This modification of the old cleft graft is also desirable for use on ordinary fruit trees.

FIG. 8. GRAFT FOR IN-DOOR USE.

AN IN-DOOR GRAFT.—A method of grafting which succeeds very well on small wood in the greenhouse, or under frames, is shown in the engraving, Fig. 8, except that the stock is not at first wholly removed, as there shown, but part of its foliage is removed to give sap to the scion. The cut is made into the side of the stock, with its lower edge cut slanting, and the bottom of the scion has a slanting surface to match. The scion is then pushed closely down so that the proper bark contact is made on one side at least, and tied and waxed, though the wax is not essential if the fit is well made and the atmosphere not too dry, nor the heat too low. Fig. 8 shows such a graft with the tie removed after the growth has started on the scion. When this growth is sufficiently under way, the old stock is removed by a sloping cut, unless it is desired that both stock and scion should grow.

PLANTING THE OLIVE.

There is nothing gained by planting out the olive too early in the spring. Both cuttings and rooted plants will do better if planted after the soil becomes well warmed, and after the heavy rains of the winter are well over. Of course the time when this condition comes is different from year to

year, and varies, also, according to locality and situation. During the first summer the young plants will need occasional watering in some situations; in others merely mulching, or keeping the surface finely stirred, will suffice.

Olive trees are planted at different distances. Mr. Cooper plants twenty feet apart in squares. He has had to remove every other diagonal row in his fifteen-year-old orchard, which leaves the remaining trees about twenty-eight feet apart, but he is still planting young orchard at twenty feet, thinking it more profitable to thin out than to plant fewer to the acre. The Kimballs, of National City, plant twenty-five feet apart.

PRUNING THE OLIVE.

In the pruning of olive trees there is less uniformity of method than in the practice among growers of other fruits in this State. Mr. Cooper believes in heading high and forming a close tree with a main stem. His method is as follows:—

The cutting will throw up numerous shoots or sprouts, all of which should be left to grow the first year; however, where there are two or more vigorous shoots of about the same size and height from the same cutting, pinch the tops of all excepting the one to be left for the future tree, so as to throw force and vigor into that one. In the following spring, when the ground is warm and sufficiently dry, all sprouts excepting the one to be preserved, should be carefully removed, cutting them off close to the cutting. The top end of the old cutting should also be removed with a sharp saw. A post should be firmly planted, so that the tree can be well secured, to keep the trunk straight, and avoid any disturbance of the roots, and should be kept until the tree is four or five years old. The lateral branches should be allowed to grow until the tree is two or three years old; but in every case when any of said branches are rapidly making wood, they should be removed, and not allowed to rob the trunk.

In the pruning during the first years, have only the one object in view, that is, to force all the woody growth into one main trunk. This being done, the tree will naturally form a beautiful shape. All branches to the height of five and a half feet should be removed, so as to admit of close cultivating by horses, but the tree should be allowed to grow until eight or ten feet high before these lower branches are removed.

Some growers do not approve as high heading as practiced by Mr. Cooper, which requires a specially-arranged wagon for gathering the fruit, as will be presently described, but endeavor to secure a lower head, at the same time repressing the groveling tendency of the tree by checking the shoots which have a downward tendency. This method resembles, in its main features, the training commended by a foreign writer, whose illustrations are presented herewith:—

When the young tree has attained some height, it is the practice to cut off the top, so that the main stem shall be about four and a half feet in rich soil, or three feet in poor soil or in locations exposed to strong winds. Six or eight branches are left to form the head. The process of shaping the tree then proceeds, as shown in the engravings. Fig. 1 shows the young tree to be cut off at the point marked by the dotted line *C*. Six branches, three on each side, are left, and the lower twigs shortened. Each of the branches left develops, during the year, as the one shown in

Fig. 2, which is then cut at *C* again, and the shoots, *B* and *D*, are shortened. This process starts out the upper shoot, and it appears the following year as *A* in Fig. 3, and it is again cut at *C*. This causes the two upper shoots to develop, and at the end of the year they appear, as shown at *BB* in Fig. 4. Thus they stand at the fourth year's pruning, and each of them is cut at *C*, and *A* is shortened and *D* allowed

FIG. 1.

FIG. 4.

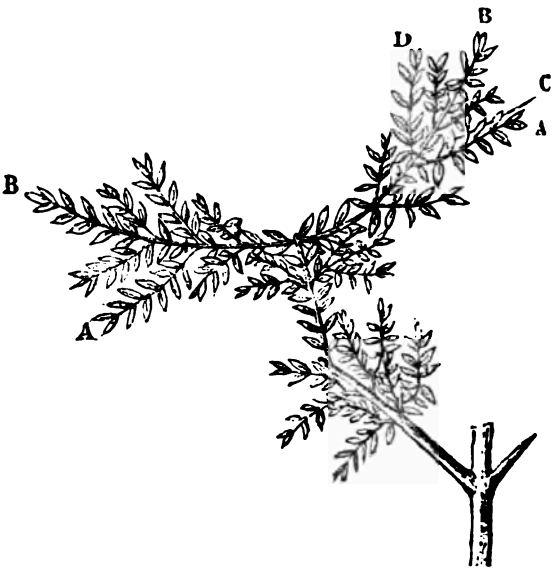


FIG. 3.

FIG. 2.

THE VASE SYSTEM OF PRUNING AS APPLIED TO THE OLIVE.

to develop. By this time the tree has a spherical or vase form, and exposes much surface to the sun, which is desirable.

The young branches that spring in the form of a cross on the more vigorous branches, bear only wood buds; the others, which are weaker, bear fruit buds on their whole length and burst into blossom at the spring of the second year. The latter never blossom again in the same place, but the shoot extends itself and forces two lateral ones. These new shoots bear the following spring, and so on. It must therefore be always borne in mind that the olive bears only on the two-year-old wood. If the new shoots are formed every year, the olive will bear annually; but in years of good crops, the sap employed to nourish the fruit only produces a number of very diminutive shoots, and the next crop is a short one. The pruning ought to favor the growth of young lateral shoots, either by shortening the terminal ones, suppressing the "gormand," or fruitless shoots, or by reducing in a certain proportion, each year, the fruit-bearing shoots, if we wish for a crop every year. The shortening of a branch is made immediately above an outside bud in an oblique direction, the interior one being suppressed. The suckers at the root of the tree should be continually cut off.

Concerning the time for pruning, the best season is said to be when the winter frosts are well over and just before the sap starts in the spring. By early pruning the sap is made to act upon the buds unfavorably situated on the tree, brings them out, and also develops latent buds on the old wood. Thus one is enabled to prevent the tree from becoming covered with naked limbs.

THE FRUIT AND ITS GATHERING.

The olive tree blooms early in May, and the fruit of the Mission variety ripens from November to January, according to the season and the locality. The olive bears on two-year-old wood. It is usual to count on getting a crop worth picking when the tree is four years old from the cutting; some of Mr. Cooper's trees of that age have borne two gallons of olives. In a weighing of the crop of an orchard he found he had gathered an average of one hundred and twenty-two pounds from trees seven years from the cutting.

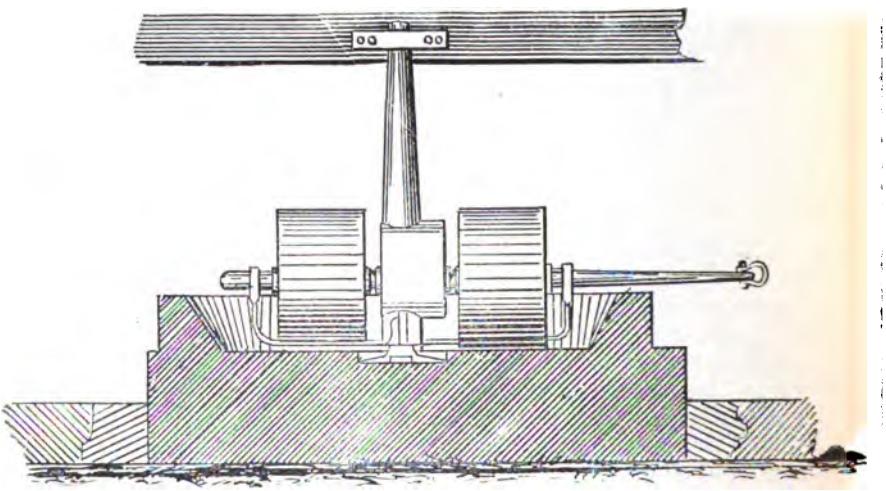
Mr. Cooper's method of gathering olives for oil-making is described as follows:—

The fruit should be gathered as soon as it turns purple, and before fully ripe, as the oil will be lighter in color and more fragrant, but somewhat less in quantity. I have arranged on a ranch wagon platforms with ladders securely fastened, so that the fruit from even large trees can be gathered from the wagon, which is driven along the rows, and one half of the trees picked from each side. This plan obviates the necessity of moving ladders, climbing, etc., and relieves the pickers from the labor of carrying the fruit, as the sacks containing the same are always at hand on the platform. The pickers have a contrivance which is buckled around the body and clasped around the neck. It makes a receptacle in front into which the olives are gathered rapidly by using both hands for picking. The leaves and imperfect berries are separated by passing the whole through a winnowing mill. This process leaves the fruit in the best possible condition preparatory to manufacturing the oil.

THE MANUFACTURE OF OLIVE OIL.

Olive oil is made in this State by the European method, though we have as yet but very simple establishments, and, as a rule, make only one, and at most but two, pressings of the pomace, which is then used for fattening swine. In the frequent working over of the pomace, and the close extraction of the oil, as practiced in Europe, we have done nothing as yet.

Olive oil is made on a small scale by a number of parties who use home-made contrivances, or small, portable cider machinery for the crushing and pressing. There are three establishments which rise to the dignity of "mills:" Frank A. Kimball's, at National City, San Diego County; Ellwood Cooper's, at Santa Barbara, and E. Goodrich's, at Los Gatos, Santa Clara County. It is probable that several others will soon be erected, some being "custom" or "co-operative" mills for using the olives produced by small growers.



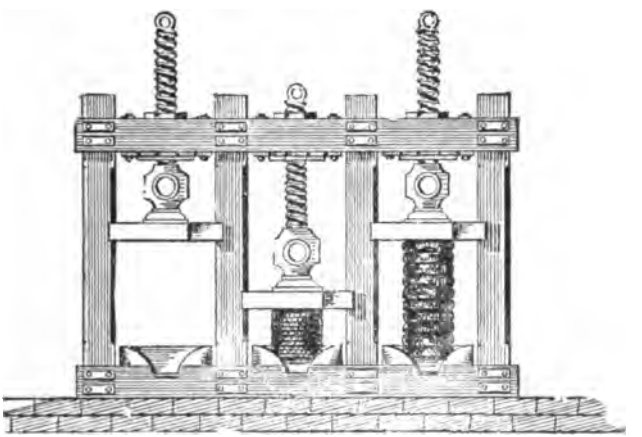
AN ITALIAN OLIVE OIL MILL.

DRYING.—Unless the olives are left on the tree until shriveled (which is not a good practice), the berries need drying before being crushed for oil. This drying may be done in the sun, and, probably, will be thus accomplished in the interior, if olive oil making should extend thereto. Mr. Kimball dries his olives by spreading them out on the floor of the second story of his large brick oil mill, and finds that it takes about two weeks to dry them. Mr. Cooper dries the olives in an artificial drier, at a temperature not exceeding 130° Fahr., drying them sufficiently in twenty-four hours. He has his drier of the same daily capacity as his mill, and regulates his picking so that just about the requisite amount of fruit is gathered.

CRUSHING.—The olives are crushed by heavy stone rollers revolving in a circular depression in a bed of masonry into which the fruit is placed. The principle is the same as in the foreign crusher, of which an engraving is given. Mr. Kimball uses a stone about six feet in diameter and with about a foot face.

Mr. Cooper formerly used a stone, but has substituted two iron crushers, one following the other over the fruit. Mr. Kimball works his crusher and his presses by steam-power; Mr. Cooper uses horse-power, and has the apparatus so geared that the horse works outside the building, which is an advantage in point of cleanliness and otherwise.

PRESSING.—When the revolving crusher has reduced the olives to a mass, which Mr. Cooper aptly describes as resembling blackberry jam in its appearance, the pomace is shoveled up



OLIVE OIL PRESS, SHOWING MODE OF FILLING.

from the bed of the mill and prepared for pressing. Instead of the fabric of woven esparto grass which is used abroad, Mr. Cooper uses coarse linen cloth. A certain amount of the pulp is put in each cloth, so that when the cloth is folded back it makes a cheese about three feet square and three inches thick. Ten or more of these cheeses are placed one above the other, with slats between, and the pressure applied gently. Mr. Cooper uses an old-fashioned cider press with a beam twenty-six feet long, which, when weighted with rocks at its outer end, exerts a heavy pressure on the pomace. Screw presses are more convenient and require less space. Mr. Kimball uses screw presses, operating them by steam-power. The engraving of an Italian oil press will give a general idea of the way the pomace is arranged for pressing. Modifications of press appliances have been made in this State.

SETTLING AND CLARIFYING.—The liquid from the press is dark colored, and it is conducted into a receptacle for settling. Much of the foreign matter quickly separates, the oil appearing

on the top. The oil is removed to other receptacles in which it can stand from two to five months for perfect separation of undesirable sediment. Mr. Kimball allows his oil to stand in galvanized iron tanks. Mr. Goodrich has a stone tank made of marble slabs. It is requisite that a receptacle should be used which will not impart flavors to the oil.

After the long standing described, the oil is filtered before bottling. Mr. Cooper uses cylindrical tin vessels holding about three gallons each, one fitting in the other in tiers of three, with fine wire sieves in the bottom of each. On these sieves he places two or three layers of cotton batting. The oil is passed from one tier to the other until clear. Mr. Kimball uses a filter made of a layer of hair-cloth, over that a felt cloth brought from Italy, and over that a thick layer of cotton and linen fiber.

OIL MAKING ON A SMALL SCALE.—There has been oil produced by a number of small growers by using "picked-up" machinery and home-made devices. The following is the method followed for several years by Colonel George F. Hooper, of Sonoma Valley, who has produced considerable quantities of very excellent oil:—

The ripened berries are carefully picked by hand, and spread to dry upon the floor of a loft where the air circulates freely. They are stirred and turned over from time to time, with a wooden rake, to prevent their molding and facilitate drying, and in the course of thirty days, or thereabout, are ready to be ground.

A KEYSTONE CIDER MILL (No. 2).—This device has two chilled-iron rolls, one concave and the other convex, placed horizontally. These rolls can be set at any desired distance apart; they are so geared that the convex makes two and a half revolutions to one of the concave; they have low, sharp ridges, running lengthwise, and when the berries are fed from the fan hopper into this little mill, as one admiring spectator remarked, "It jost chews them up," stones and all.

The ground olives are then placed in an eighteen-inch tube, lined with coarse Russian crash, and put under the wine press, the platform of the press being fitted with a tin cover, which keeps the oil from the wood. After pressing once, the "cheese" is broken up and subjected to a second pressure; then they break it up again, mix water with the fragments and press a third time, after which the pomace is fed to the hogs or used for fuel.

The juice from the pressing is caught in large tin vessels, where it is kept for about a month, being skimmed every little while, and occasionally turned from one tank into another, to promote the separation and rising of the oil. The proportion the oil bears to the whole bulk of liquid expressed is about one-fourth of the first pressing and half the second. It takes about seventy pounds of the fresh fruit, or forty-nine pounds of the dried, to make a gallon of oil.

Before bottling the oil, it is filtered through cotton batting. A convenient filter is made by fitting a large tin pail with four or five perforated false bottoms or strainers. These are graded in size, so as to lie one above another, an inch or two apart, in the tapering pail, with layers of batting on each strainer. At the lower end is a funnel through which the filtered oil runs into the tank, from which it is drawn by a faucet into the bottles.

Olives are sometimes ground in barley crushers for oil manufacture on a small scale. As the above description shows,

oil making is a simple process, and may be carried on at home with rude devices. It is, however, a process requiring care and cleanliness, and intelligent personal attention.

COST OF AN OIL OUTFIT.—There is, of course, wide variation in the cost of an oil mill, and there is a disposition now to make considerable investment in buildings and appliances. The beginner will find it interesting to know what Mr. Cooper gives as an estimate of the cost of such an outfit as he used successfully for a number of years. It is as follows: Olive drier, $150; mill, $250; two presses, $500; two tanks, $200; filters, $50; corker and tinfoiler, $50; wooden building, $400; total, $1,600.

PICKLING THE OLIVE.

There is a multitude of recipes for preparing the olive for table use. They differ in the main in the use of alkali for removing the bitterness, or trusting to soaking in fresh water to remove it. Mr. Cooper relies upon the latter method, which he describes as follows:—

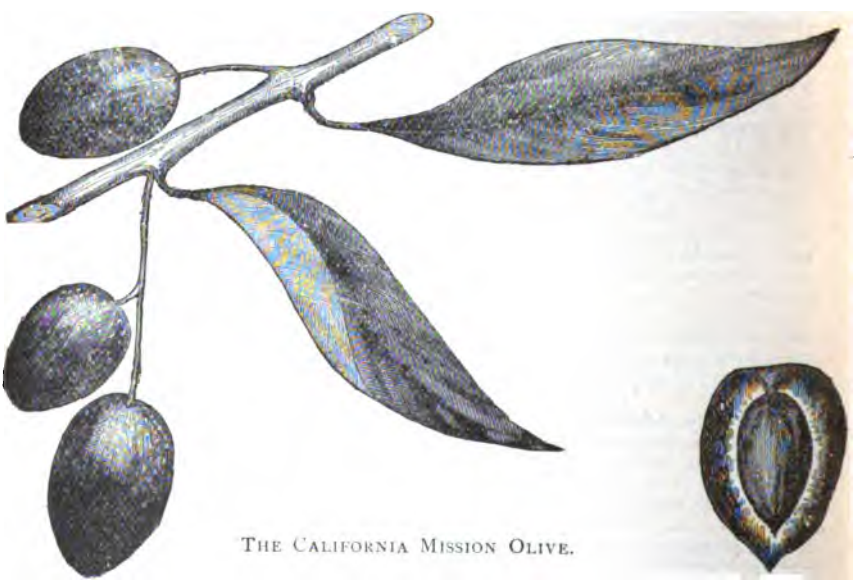
If it is desired to have ripe olives pickled, they should be gathered when of purple color. They must be picked and handled with great care. We pick them in water; that is, pick them and drop them in water, so they won't be bruised, and we take into the field a tub with water in it and the pickers empty into that, so that there cannot be any bruising. Even in pickling them we handle them in water, and we aim when we are changing the water to get the olives that are in the bottom one day on top the next, changing the water every day, and in that way you will not find one that is imperfect. After changing the water every day for thirty or forty days, according to the ripeness of the olive, we make a mild brine of the best Liverpool salt, about half as strong as would bear an egg, and leave it in that brine two or three days. Afterwards take the olives out of that brine and wash them in cold water. Then we make a brine that will just about bear an egg, boiling the brine, and in that keep them for an indefinite period. I have kept them three years, and every olive that comes on the table is just as perfect, just as full, as when picked from the tree.

Frank A. Kimball, of San Diego, who has the reputation of preparing as good olives as are marketed in California, uses the following method:—

Carefully pick the olives, keeping those of same color together—all green, all red, or turning red, or black—put them in a vessel which is absolutely free from any taste or smell. Take of American concentrated lye two ounces for every gallon of olives; dissolve the lye in clean water sufficient to cover the olives (it is best to boil and skim it); then pour the lye over the olives. I prefer to have it cold. Be sure every olive is covered with the lye. Don't let *one* come to the top of the water. Stir them occasionally—say two or three times in twenty-four hours; then taste them and see if any bitterness is left—if so, let them remain twelve hours longer. If then bitter, pour off lye and repeat with half the quantity of lye, and when no bitterness is left, pour off the lye and replace with fresh water, changing it two or three times each day, and in two or three days the lye is all out and they are ready for salt, and this is all governed by taste. If you get them too salt, they are easily freshened as they are required for use. Black or ripe olives require a large amount of salt to keep them. Do not fail to keep every olive under the brine. The best test for lye, when washing the olives before salting, is litmus paper dipped in the water. This will detect the slightest particle of lye.

VARIETIES OF THE OLIVE GROWN IN CALIFORNIA.

In view of the large collections of choice olives brought to California during the last few years from the different olive-growing countries of Southern Europe, it may be inferred that we are now well supplied with the best sorts, but how rich is our possession, and how well the varieties will suit California conditions, is not yet known, as comparatively few of the importations have borne fruit. Much will be learned in this direction during the next few years. It is interesting, however, to show the olives now most widely grown in this State, and some of the lately introduced kinds which have fruited here. For the illustrations used in this connection, indebtedness is acknowledged to the publication by Mr. Lelong, secretary of the State Board of Horticulture. In the office of the State Board, at 220 Sutter Street, San Francisco, a large collection of olive varieties can be seen, as well as much other material of interest and value to the horticulturist. The descriptions of the varieties mentioned are chiefly by the late W. G. Klee.*



THE CALIFORNIA MISSION OLIVE.

THE MISSION OLIVE.—By this name is signified the variety found growing at the old missions in California. Samples of the fruit and leaves sent by F. Pohndorff to Don Jose de Hidalgo Toblada, a noted Spanish authority on the olive, led to the classing of our mission varieties with the Cornicabra-Cornizuelo varieties of Spain, and its value was confirmed.† It has long been known that the so-called

* Bulletin 85, University Experiment Station, Berkeley.

† A fuller statement in *Pacific Rural Press*, April 4, 1885.

REDDING PICHOLINE—NATURAL SIZE.

Mission olive embraced several varieties, or sub-varieties at least.

Common or Broad-leaved Mission Olive.—The variety of olive most generally known as the Mission, thirteen-sixteenths of an inch long by ten-sixteenths of an inch thick; ovate, oblique —sometimes very much so— the pit straight or slightly curved, ten-sixteenths of an inch long and five-sixteenths of an inch thick; fruit very variable in size, growing singly or in clusters of two or three, or even five; time of ripening, late, in the coast region; sometimes not before February, but generally in December; in warmer localities, in November.

Other Mission Varieties.—On the University experimental grounds there are now being propagated three apparently quite distinct kinds: (*a*) Broad-leaved or Common Mission (already described). (*b*) Narrow-leaved Mission, a variety received originally from L. A. Gould, of Auburn, described as having a somewhat larger fruit than the common Mission, and a more straggling habit. (*c*) Early Mission, procured from A. A. Wheeler. It is of the Mission type, but ripens at the end of October in Alameda County.

THE TRUE PICHOLINE.

REDDING PICHOLINE.—Imported by the late B. B. Redding. A perfect oval in shape, eight-sixteenths of an inch long and six-sixteenths of an inch thick; pit six-sixteenths of an inch long by four-sixteenths of an inch thick; ripens early, several weeks earlier than the common Mission; dark purple or black when ripe; in pickling, the pulp loses the bitterness quickly, the fruit being very pleasant. This variety has been propagated extensively in the State, and, until fruiting, was supposed to be a large pickling variety; then, not having an adequate description of the Picholine at hand, it was believed for a number of years to be rightly named after all, various authors designating the Picholine as a small olive. Two years ago, in the Annals of the School of Montpellier, France, there appeared a description of the Picholine as known

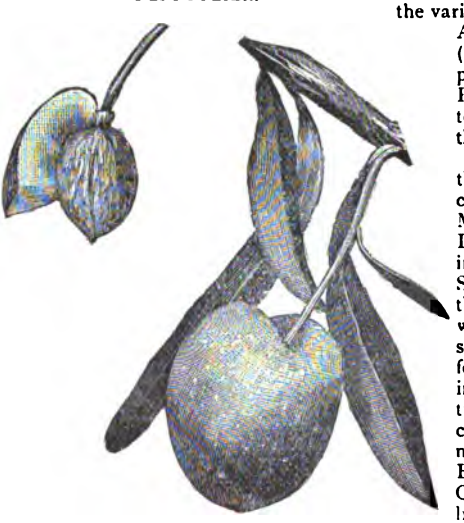
there. Mr. B. M. Lelong had this promptly translated for his report, and deserves credit for having thus settled that the variety of Redding's introduction is not the French Picholine. The Redding-Picholine, which name has naturally suggested itself for want of a better, has produced oil of good quality.

PENDOULIER.

PICHOLINE.—A variety believed to be the true Picholine is now fruiting at several places in this State under the name Oblonga, which is one of its synonyms. It is described by a leading French authority as a very delicate olive, sometimes used for oil, but chiefly for pickling.

OBLONGA.—Imported by John Rock from France. An olive of a peculiar, club-like shape, being narrow at the stem end, broad at the point, rounded and strongly oblique, fifteen-sixteenths of an inch long and eight-sixteenths of an inch in thickness; pit curved, eleven-sixteenths of an inch long by four-sixteenths of an inch in thickness; generally pointed at both ends. The pulp loses its bitterness comparatively quickly in pickling. This olive ripens quite early—at least two to three weeks earlier than the broad-leaved Mission; color, dark purple.

Coutance, as well as several other authors on the olive, gives the name of the Picholine as synonymous of *Oblonga*. As a matter of fact, the olive imported by Mr. Rock under the name of *Oblonga* is a totally different-looking olive from the variety described and pictured in the Annals of the School of Montpellier (and translated in Mr. Lelong's pamphlet on olive varieties) as the Picholine. Rock's *Oblonga* seems to belong in the neighborhood of the *Lucques*.

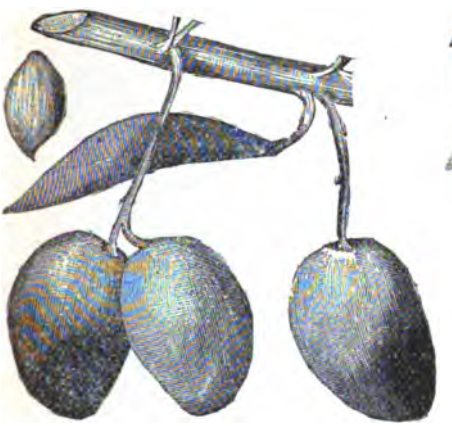


MANZANILLO.

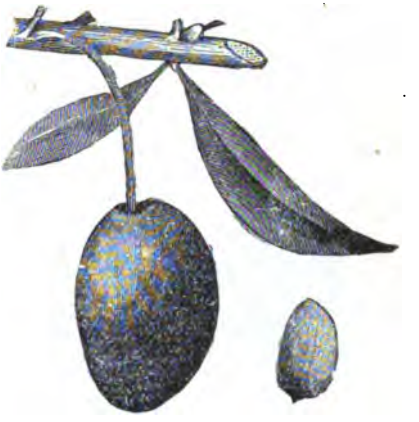
PENDOULIER.—At Vacaville this variety is growing in the orchard of Mr. A. Montpellier. Mr. Montpellier imported his trees from Italy in 1885. The fruit ripened in the first part of October. At Sonoma this variety is growing in the orchard of Mr. L. P. Rixford, who imported his trees from France some ten years ago. The trees, four years after planting, bore fruit in great numbers, and have continued to bear good and regular crops every year; they ripen at Sonoma in November. Mr. George E. Ladd, of Atwater, Merced County, has also a few trees which bore fruit in 1888 for the first time. They ripen there about the same time as at Vacaville.

MANZANILLO NO. 1.—Imported by F. Pohndorf, from Spain, and grown by Juan Gallegos, Esq., at Mission San Jose; large, one inch long by thirteen-sixteenths in

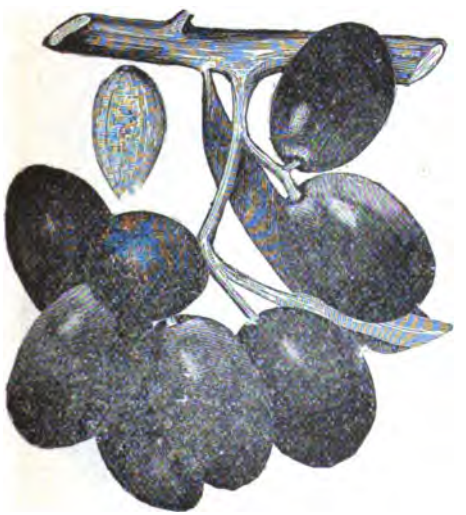
thickness; regular rounded oval; pit straight, strongly pointed at the apex, nine-sixteenths of an inch long, five-sixteenths of an inch thick. Ripens early, several weeks earlier than the broad-leaved Mission. In many respects this resembles the *Sevillano Gordal*, or Queen Olive of Spain, more than any variety I have examined in this State. The fruit grows on long stems, and in a windy place would be liable to fall. The pulp parts readily with its bitterness, and is exceedingly rich when pickled.



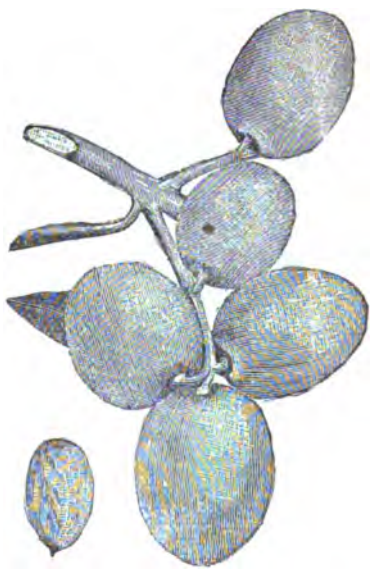
RUBRA.



PENDULINA.



UVARIA.



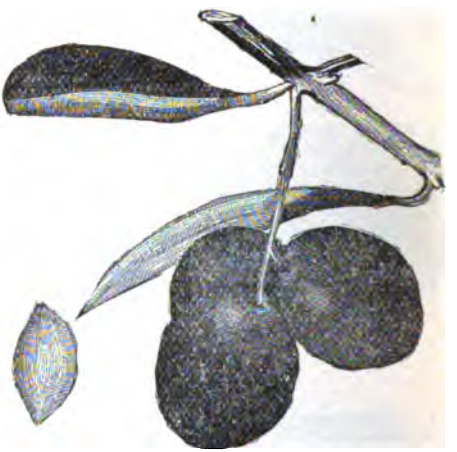
COLUMELLA.

MANZANILLO No. 2.—Imported by F. Pohndorf from Spain. As the name ("small apple") indicates, this variety is of an unusual shape, only one—the Dalmatian (*Hertaza*) resembling it. It is nearly round, with a pit of rounded oval

shape, rather squarely cut off at the base. As the specimens were few and not quite fully grown, measurements are not given. This variety ripens early—several weeks earlier than the broad-leaved Mission olive; the fruit grows generally singly on long stems.

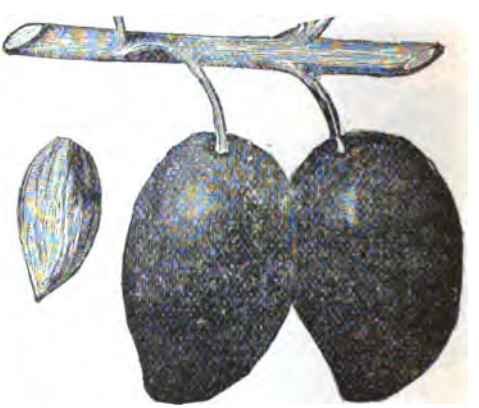
RUBRA CAILLON.—Imported by John Rock from France; ovate, slightly oblique, looks a good deal like a small Mission olive, twelve-sixteenths of an inch long, and eight-sixteenths of an inch thick; pit straight, pointed, eight-sixteenths of an inch long and four-sixteenths of an inch thick. This variety is an early one, and ripened three to four weeks earlier than the common Mission variety; is of a jet black when ripe. This tree begins to fruit quite young, and is a prolific bearer. Generally considered one of the most promising of the newly-imported varieties.

ATRORUBENS OR SAILLERNE.



ROUGET.

LUCQUES.

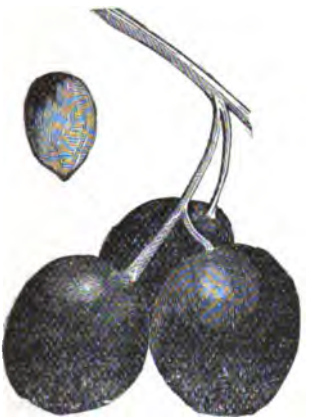


MACROCARPA.

UVARIA.—Imported by John Rock from France. Oval, regular, and rounded on both ends; thirteen-sixteenths of an inch long and nine-sixteenths of an inch in thickness; pit straight, heavy, ten-sixteenths of an inch in length and six-sixteenths of an inch in thickness; late; later than the common Mission olive; color dark pur-

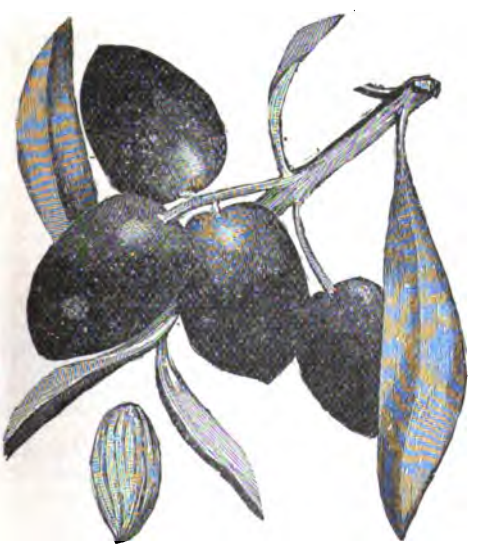
ple or black when ripe. The name, "grape-like," is well chosen, the fruit growing in clusters, as many as seven together, and in shape themselves resembling the grape. Very prolific.

PENDULINA.—Imported by John Rock from France. This variety is of an even, oval shape, rounded at both ends, quite variable in size, many fruits remaining small and undeveloped; twelve-sixteenths of an inch long and nine-sixteenths of an inch



VERDALE.

PIGALE.



ATRO-VIALACEA.

OLIVIERE.

thick; pit seven-sixteenths of an inch long, four-sixteenths of an inch thick, exclusive of the small, sharp points often found at both ends. The fruit grows in clusters of from two to five; the pulp parts very readily with its bitterness. This variety must

not be confounded with the Pendoulier, a variety imported by Mr. Albert Montpellier, and fruited at his place at Vacaville. The latter variety is somewhat larger and more of an ovate shape.

COLUMBELLA.—Imported by John Rock from France. General form, broadly oval, fourteen-sixteenths of an inch long and eleven-sixteenths of an inch thick; very even in size, remarkable for the peculiar pale yellow color which all the fruit assumes before turning fully ripe and becoming dark purple; pit small, eight-sixteenths of an inch long by five-sixteenths of an inch in thickness; straight and sharp-pointed; the pulp seems to part with the bitterness slowly, but, when extracted, the flavor is very rich; ripens late, later than the broad-leaved Mission.

ATRORUBENS.—Imported by J. Rock. According to Coutance synonymous with *Salierne* or *Sayerne;* of a violet black color, covered with bluish bloom, rounded at the base, pointed at the top; cultivated throughout Languedoc; valuable for oil.

POLYMORPHA.—Imported by John Rock, from France; very large, ovate, oblique, and pointed; thirteen-sixteenths inches long by twelve-sixteenths of an inch thick; pit twelve-sixteenths of an inch by six-sixteenths in thickness, square at the base, strongly pointed at the apex; flesh firm. Time of ripening falls much like the broad-leaved Mission; fruit grows on strong stems in clusters of two or three.

ROUGET.—Fruited under its synonym *cayonne;* a hardy variety, adapted to poor land; yields a fair oil, but mostly used for pickles.

VERDALE.—Fruiting in several parts of this State. At Saratoga it is in bearing on very steep side-hills, so steep that they can hardly be cultivated. The trees in 1888 were full of fruit and doing well. The French describe the tree as rather sensitive to cold; very early; not adapted to poor soil, nor for oil making, but fine for pickling green.

OLIVIERE.—A very hardy and long-lived variety; widely grown in Languedoc for its oil.

LUCQUES.—A variety specially adapted for pickling, though producing oil of good quality; now fruiting with C. A. Wetmore, of Livermore.

PIGALE.—A late variety, commended in France to prolong the picking season; adapted for pickling and oil making.

MACROCARPA.—A very large-fruited variety, and early; only grown for pickling; resembles Polymorpha.

ATRO-VIALACEA.—A vigorous and productive variety, commended both for oil and pickles.

REGALIS.—Imported by John Rock from France. Almost perfectly rounded—oval; when ripe, dark purple or black; large, one and one-sixteenth inches long by thirteen-sixteenth inches in thickness; flesh firm; pit nine-sixteenth of an inch by five-sixteenth of an inch, generally straight, square at the base, pointed at the apex; ripens slightly ahead of the broad-leaved Mission variety.

NEVADILLO BLANCO.—Imported by F. Pohndorf from Spain. Oval, slightly oblique, pointed, one inch long by ten-sixteenths of an inch thick; resembling somewhat a broad leaved Mission, but is generally more elongated in proportion to its diameter than the latter; pit small, curved, and generally pointed at both ends; ten-sixteenths of an inch long by four-sixteenths of an inch thick; the fruit is borne in clusters of three to five; its time of ripening does not appear to be much earlier than the broad-leaved Mission.

This variety has been propagated considerably at the University Experiment Station, and has been scattered widely by distribution. The reports received from these trees go to show that it is a remarkably robust and fast grower in the hottest as well as in the cooler portions of the State. Should this olive prove a good and constant bearer, as there is every reason to believe, it will prove a valuable addition to our varieties of olives. Its time of ripening may be an objection to its planting in localities near the coast, subject to early frosts. Reports indicate that it is more tender to frost than certain other varieties—a fact which is undoubtedly due to its almost constant growth, and shows that moist soil should be avoided for this variety perhaps more than for any other.

RAZZO or FRANTOJANO.—Imported by Judge J. R. Logan, of Santa Cruz. An olive from the Lucca district in Italy. Oval, medium size or below; it yields in its native country a very fine oil.

CORREGIOLO, or GROSSAJO, or FRANTOJO.—Imported by Judge J. R. Logan, of Santa Cruz. An olive from the Lucca and Pisa district in Italy, furnishing some of the finest oil. Fruit medium-sized, of inverted oval (obovate) shape, narrow at the stem end, broader toward the point.

AMELLOU, or OLEA-AMYGDALINA.—Imported by Mr. C A. Wetmore. A large variety, valuable both for oil and pickles.

OBLITZA.—Obtained from Mr. George Ladd, of Atwater; imported by the late N. Milco, from Dalmatia; resembles somewhat the Pendoulier of A. Montpellier, near Vacaville. Further examination is necessary to determine whether the two are identical.

HERVAZA —Obtained from the same source as the above; much resembles the Manzanillo in shape, but the pit of the fruit is more squarely cut off than that of the latter. The trees of the two varieties are totally distinct. The Manzanillo has an upright, sparse growth and dark-colored wood. The Hervaza is of drooping habit, and the wood is light-colored. Time of ripening of the two falls about the same at Atwater, viz., in the beginning of October.

The foregoing enumeration and description of varieties is only partial and tentative. During the last two years large collections have been imported by olive growers, and are not yet in bearing, or have not yet been carefully studied. The list given, however, includes those which have been most widely distributed, as well as others which have not been commercially propagated. Several years must elapse before we can ascertain what varieties are now possessed by Californians, and much longer to determine which are best adapted to our conditions, and are most profitable.

CHAPTER XXXI.

THE ORANGE.

THE orange has held a leading place among California fruits ever since the American occupation, and at present is attracting wider attention than ever before. Its position as a commercial fruit has been attained in Southern California—the three counties of Los Angeles, San Bernardino, and San Diego being the only counties which have thus far produced more than enough to supply home requirements, and only one or two other counties have done even that. In 1890 the shipments to near and distant markets from these three counties reached about three thousand five hundred loads. And yet the orange tree has demonstrated its success in many other parts of the State by decades of thrift and fruit bearing, and recently very large plantations have been made in the Sierra foot-hills, and on the east side of the Sacramento Valley, notably in the Oroville region.

Recently the orange has been put forward prominently as the exponent of climate. The natural desire of all sections which can claim the possession of semi-tropical weather conditions, to demonstrate their claims, has resulted in local displays of citrus fruits at which creditable oranges have been shown from trees situated as far north as Shasta County. The explanation of this fact is to be found in the statements made concerning the climates of California, and their effects upon the growth and ripening of fruits, in Chapter I, and need not be repeated in this connection.

Both the old and the new notions which the public has indulged in as to the adaptation of the State for the growth of the orange, are wrong. To conclude, from the commercial supremacy of the southern counties in orange production, that all the southern country is fitted for the growth of this fruit, and that more northerly countries are not, or to decide from recent fruit exhibits that all the North is thus endowed, are both incorrect and misleading. Certain southern situations have been proved to be unsuited for profitable orange production, and certain northern sit-

uations are also unfit. The limitations at the South are quite well understood because of the greater attention which has been paid to this fruit; the limitations at the North are very likely to be soon learned, because of the general planting which has been done during the last few years. With all trees to be had in Southern California nurseries, and all that were brought from Florida, the demand for planting in the spring of 1888 could not be supplied, and since then the planting has kept pace with the increased propagation. There will be a vast growth in the orange product both North and South, and, fortunately, the success which the oranges of California are achieving in distant markets gives promise of adequate rewards for well-directed enterprises. The premiums won by California oranges at the New Orleans World's Fair* gave us a name at the East, and shipments to Eastern cities since that time have been very profitable. The fact that the California oranges reach the Eastern market after the Florida product has been disposed of, is of advantage to both Sates.

Though the California literature of the orange, aside from the newspaper and the magazine, is not large, it includes several excellent contributions by well-informed writers, to which the reader is referred.† A systematic examination of California-grown citrus fruits now in progress in the laboratory of the Univerity Experiment Station, at Berkeley, is yielding exact information of much value.‡

SITUATIONS AND SOILS FOR THE ORANGE.

Though it is acknowledged to be impossible to speak geographically concerning the success of the orange, there are a few generalizations concerning suitable conditions which may assist the planter in choosing locations.

It has already been stated (page 21) that the lowest temperature reached in our fruit districts since American occupation, which was in January, 1888, did not, as a rule, seriously injure mature wood of the orange, but it should be pointed out that in-

*Premiums awarded in competition with outside regions were as follows: Best collection not less than twenty varieties from any State or foreign country. Riverside Fruit Co.; best collection ten varieties, *do.*, *do.*, Kimball Bros., National City; best plate any variety, *do.*, *do.*, Kimball Bros.; best collection from any State, Riverside Fruit Co —and a large number of individual rewards. See Report American Horticultural Society, Vol. III, page 221.

†"Orange Culture in California," by Thomas A. Garey, published by Dewey & Co., of San Francisco, 1882; 12mo., 227 pages.

"The Orange: Its Culture in California," by W. A. Spaulding, published by *Press and Horticulturist*, Riverside, 1885; large 8vo., 97 pages.

"A Treatise on Citrus Culture in California," etc., by B. M. Lelong, secretary State Board Horticulture, published by the State; 1888. 8vo., 96 pages.

Essays by various writers in Reports State Board Horticulture, 1886 to 1890; published by the State.

‡"Investigation of California Oranges and Lemons," University Bulletin 93, by G. E. Colby and H. L. Dyer, 1891.

jury to mature wood is wrought much below the limit of safety to the product. The fruit is very liable to injury at a slight drop below the freezing point, and where such temperature is reached every winter, the orange tree would be little more than ornamental. Even in our best orange regions there is occasional injury to the fruit and to young trees, and apprehension is felt as the frost season approaches, but this, of course, is the case in many other orange regions of the world.

Situations not far distant from each other often differ greatly in suitability for the orange, the chief elements of the variation being elevation, exposure, and soil. The following statement by J. W. Sallee, of Pomona, Los Angeles County, presents conclusions after much observation at the South:—

The soil should be deep rich alluvium, formed from granite and limestone. A hard-pan subsoil should be avoided, while strata of sand and gravel are very objectionable. A red subsoil—commonly called clay in California—formed from disintegrated granite, well rotted, is best. A black or adobe subsoil is not good. The subsoil should be fine, but of a nature to allow water to pass freely through it. It should be deep and rich, with water not less than thirty feet from the surface. The surface soil should be of a sandy nature, so as not to bake after irrigation. Coarse sand and gravel are not objectionable on the surface, provided the subsoil is all right. A sediment surface is good; in fact, any kind of soil easily pulverized. The surface of the country should have a southern exposure, and, better still, to be backed on the north by high hills, and should be comparatively free from winds and frost. The hotter the locality the better. An altitude from eight hundred to one thousand six hundred feet is best. Be sure to have an abundance of water that can be relied upon for irrigation—at least one inch to every five acres of orange orchard. More will be needed when the orchard grows old.*

The elements entering into suitability of soil and situation at the North are sketched by the late Dr. John Strentzel, who began orange growing in Contra Costa County in 1853, as follows:—

It is now demonstrated that oranges are grown all over California, still it does not follow that this child of a tropical climate can withstand the effects of uncongenial soil and the occasional rigors of a northerly climate, thus depriving it of food and shelter. To succeed, great care is required in selecting the location for an orange grove. Former observation is necessary to indicate the spot exempt from hard freezing; a few feet of elevation above the surrounding surface, or a few feet to the right or left side of prevailing currents, and the shelter of a grove of trees, make a vast difference in the climatic peculiarities of a given location. One must secure a rich, deep, mellow soil, free from stagnant water; also plenty of water for irrigation during the dry season. The orange tree requires copious watering during the dry season. It is a surface feeder. The numerous rootlets spread in the ground, forming a spongy mass of fibers, which exhaust moisture rapidly. The curling and wilting of the leaves denote a deficiency of moisture, which causes also shrinkage of the fruit.

These are presented as ideals in the selection of situation and support for orange trees. Of course there are trees growing and bearing fruit in places and upon soils quite otherwise than as described; and in family orchards, where conditions do not

*Prize essay in *Pacific Rural Press*, Aug. 1, 1885.

absolutely preclude fruitage, the orange should find a place. Thrifty and profitable trees can be found even on adobe, where extra attention is given to timely and thorough cultivation. In selecting location for extended commercial planting, however, the very best situation should be diligently sought for. The provision of irrigating facilities is governed by the conditions noted in Chapter XV. In certain places good fruit has been produced without irrigation, but in situations otherwise best suited to the fruit, bearing trees will in all probability require water.

PROPAGATION OF THE ORANGE.

The orange is grown from cuttings, layers, and seeds. Growth from the seed is the method almost exclusively followed, and by far the best, but the others will be mentioned briefly.

GROWTH FROM CUTTINGS.—This method of propagation is described on page 107.

GROWTH FROM LAYERS.—The orange roots readily by layering, the drooping branches being partly cut through, buried in the soil with the terminal shoot above-ground. Layers must be kept moist. Layering may be employed to obtain a few plants easily, but, otherwise, it cuts no figure in propagation. Layers and cuttings, of course, reproduce the original variety without recourse to budding.

GROWTH FROM SEED.—Good plump seed selected from home-grown fruit may be used in growing orange seedlings either for their own fruiting or to use as stocks for budding; but there is danger, when seedlings for fruit are grown from such seed, that some results of cross-fertilization with the lemon, lime, or other citrus species, may appear in the fruit. Of course, if one gathers his own seed from a choice variety in a situation where other citrus species are not grown, his chances for good seedlings are greater, but the orange cannot be trusted to come true from seed.

The seed chiefly used in this State is obtained from Tahiti oranges. On arrival at th s port, the fruit is picked over and the decayed fruit can be cheaply bought by the barrel from the receivers. When thoroughly decayed, the fruit is pulped by mashing in the barrel, and the mass is washed, a little at a time, on a coarse sieve, the pulp passing through, and the seed being caught on the wires, and pieces of skin thrown out. The plump seed will sink if thrown into water, and the imperfect can be skimmed from the top. The seed should never be allowed to dry, and unless it is to be sown at once, should be stored by

mixing with moist sand, from which it can be afterwards removed by sifting. The best time for sowing orange seed is after the ground has become warm in the spring.

Orange seedlings are grown either in boxes or in the open ground. In either case a rich sandy loam which will not bake should be secured or artificially made by mixing sand with rich garden loam. Boxes of about two square feet area and six inches deep are convenient to handle. The bottom should have holes, or sufficient crevices for good drainage. Fill the boxes about four inches with the prepared soil, place the seeds about an inch and a half apart each way, and sift over them about an inch of the soil, or a little less of the soil and a layer of clear sand if it is at hand. It is essential that the soil should be kept moist, and light sprinkling daily or each other day with water that has been warmed by standing in the sun, is desirable. Seed can be sown in boxes in the house at any time, if plenty of light and heat are given. If the boxes are to be out-of-doors, it is best to sow in the spring, and to rig up a cover of cheap cotton cloth, suspended about a foot above the surface, to prevent effect of frost at night, and of burning by sun heat by day. The seedlings usually appear in about six weeks, and with good care in weeding and keeping sufficiently, but not excessively, moist, they will make a growth of about a foot the first season. Some growers collect the boxes in a sheltered place, and build over them a lath house, tacking on old sacks or other cloth, to shield from sun and frost. The lath house keeps animals from running over the boxes, etc.

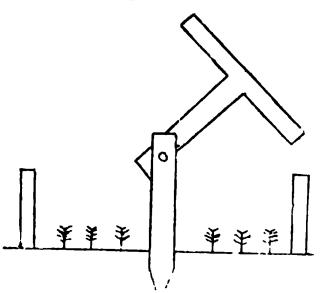
Growing seedlings in an open bed involves about the same operations. To guard against intrusion, it is advisable to make board sides to the bed about a foot high, and to make lath frames which will reach across, resting on the edge boards. A cloth sun and frost shade is also desirable, to be laid over the lath frames when it seems needed. Mr. Miles, of Placer County, has devised an adjustable cloth shade, which is shown in the engraving on the following page.

Beds should be made narrow enough so that one can easily reach half way across from each of the long sides for weeding, etc. In open seed beds it is usual to sow the seed broadcast. Mr. Lelong advises flooring the bed with boards to exclude moles, filling it with soil, so that the open bed becomes really a large, shallow box.

THE ORANGE NURSERY.—Planting out in nursery is usually done after the ground is thoroughly warmed in the spring, and the seedlings are then about a year old. The preparation of nursery ground and the planting out of the seedlings can be

done as described in Chapter VIII. Orange seedlings should, however, be given greater distance apart than is usual for deciduous trees, because the orange remains longer in nursery, and because it is often desirable, when taking up, to sack the ball of earth embracing the roots. If the roots are not to be sacked, about nine inches will do between the plants; if to be sacked, the distance should be twice as great. The rows should not be too close in the orange nursery. If horse cultivation is to be used, at least four feet between the rows should be allowed, and even greater distance is desirable. In taking the seedlings from the seed beds, a few should be lifted at a time, and their roots kept shaded and moist until the ground closes on them in the nursery row. To get an even stand in the nursery, small and weak plants should be placed by themselves, or set in boxes to take another year before going into nursery.

Young trees in nursery are very liable to frost injury, and it is wise to protect them by some sort of a cover during the winter. A framework covered with cypress brush is often used, the whole being cleared away in the spring, to allow of summer cultivation. Cultivation of trees in nursery is about the same as with deciduous fruit trees. The horse should be used, and the surface kept perfectly pulverized. The cultivator should follow irrigation as soon as the soil will admit of it. Frequency of irrigation of nursery depends, of course, upon local conditions. Some give two or three irrigations, by running the water in a little trench alongside the rows, at intervals of two weeks, and then irrigate once a month during the summer. It is important that irrigation should not be continued too late into the fall, because the young tree should harden its wood before cold weather. Nor is it desirable that the growth be too rapid. A good growth of sound wood is better than extra size.



ADJUSTABLE SHADE FOR SEED-BED.

LENGTH OF TIME IN NURSERY.—Seedlings are usually budded after being one year in the nursery, or at two years from the planting of the seed. At a convenient time in the winter the lower shoots and thorns are removed from the seedlings, so as to leave a clear stem of about six inches, for the convenience of the budder.

Budded Orange Trees of H. A. Mayhew, Niles, Alameda County.

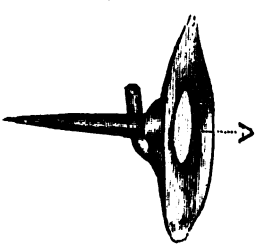
BUDDING THE ORANGE.

After years of experience and many losses and disappointments through trial of the Chinese lemon and other stocks, the firm conclusion has been reached that only the orange root is suitable for the orange tree. Orange roots are usually obtained as has just been described, but recently the sour stock of Florida has been brought in in large quantities, both as seedlings and as seed for local growth of stocks. Results thus far promise well. The many Japanese varieties now being imported are worked on the *Citrus trifoliata*, a dwarfing stock.

Budding is almost exclusively adopted in working in desirable varieties. The best time to bud is about the time the new growth starts on the seedling in the spring, though some practice budding in midsummer and fall. Good, well-matured buds only should be used; those from both base and tip of the shoots are frequently defective. The method of budding described on pages 110 and 111 is that usually employed in budding citrus trees, and the rules for loosening the ligature, etc., are similar. Midsummer buds are apt to have soft growth at the coming of cold weather; fall buds remain dormant until spring; spring buds start to grow almost immediately, and have the benefit of the whole summer season for growth and maturing of wood.

SUPPORTING THE BUD.

After the bud has started out well, the top of the stock should be removed at a short distance above the bud, and suckers on the old stock should be continually looked for and removed. The tender shoot of the bud is protected by tying to the stub, as shown in the engraving (from Lelong), and when the growth of the bud has become strong enough to support itself, the old stock is smoothly sawn away at the line **O**, and the wound covered with shellac, liquid grafting wax, or paint.



CUTTING A BUD WITH A THORN.

The care of the budded trees in nursery is similar to that of the seedlings of the previous year. If too great a tendency to branch low down is observed, the tips of the lower shoots should be pinched, but it is not desirable to underprune much; the retention of the lower branches thickens the stem. Sometimes a very rank growth on the bud will need a stake to strengthen it or protect it from blowing out. The intrusion of gophers and other vermin should be resolutely and persisently guarded against.

WORKING OVER OLD TREES.—Old orange trees can be transformed into improved varieties either by budding or grafting, as described on pages 120 and 121, though re-working by grafting has been almost entirely superseded by budding. The common way to bud over an old tree is to cut back part of the branches and force out new shoots, the best of which are selected for budding and the others removed. Only a part of the tree is removed at first, and when the new buds have grown out on that, the other part is similarly treated. Mr. Lelong describes his method of budding into old bark, thus preventing the sacrifice of time and fruit by cutting away the old wood and waiting for the new to grow. His method consists in selecting the largest buds and in taking them from the branch with an inch length of bark, also cutting well into the center, thus removing a considerable amount of wood with the bark. If it is a thornless variety, the piece of wood can be easily lifted out from the bark, and the latter with the bud is then inserted under the old bark of the stock in the usual manner of budding. If the variety has thorns, a bud having a large thorn is chosen and the wood carefully removed with the budding-knife, leaving a little wood in the bud to hold the thorn, as shown at "A" in the engraving on the preceding page. The bud is then placed under the thick bark as described. These large buds in old bark need careful tying with twine, and the ligature has to be retained longer than with young bark, because of the tendency of the old bark to draw back. The tie should, however, be loosened and re-tied so as to prevent cutting into the bark. The starting of the buds is promoted by ringing or girdling the stock about an inch above them. The old branches are left on the tree for some time to shade it, until the bud attains considerable growth, when all may be cut away but the bud growths, which will constitute a new head for the tree. All wounds made in removing the old branches should be carefully painted over. Budding in old trees is best done in the spring, when the sap flow is strong, but can be done in the fall and the bud allowed to lie dormant until spring.

PLANTING ORANGES IN ORCHARD.

As already stated, orange trees are planted out at greater age than deciduous fruit trees. Budded trees are given one or two years' growth in nursery and one or two years' growth on the bud, which, added to the year in the seed bed, makes them three to four years of age from the sowing of the seed. Seedlings, to be planted out as such, are allowed two years' growth in the nursery, which makes them three years old from the seed.

For this length of time and the unusual care involved in their growth, taking up from nursery and preparation for carriage, orange trees of planting age are of much greater cost than deciduous fruit trees.

Preparation of land for orange planting by deep and thorough cultivation and laying off to secure straight rows by the square, quincunx, and hexagonal methods have been quite fully discussed in Chapter X, and Chapter XI has suggestions for planting, many of which are applicable to the setting of orange trees. There are, however, special methods employed in lifting the orange trees from the nursery rows and in placing them in permanent position, which will be outlined.

The orange, in common with other evergreen trees, is exceedingly sensitive to exposure of its roots, and for this reason the handling of the young trees is very different from that of ordinary orchard trees. Three ways are employed for securing this constant moisture of the roots, as follows:—

PACKING IN WET STRAW.—As fast as the trees are lifted from the nursery ground by digging carefully so as to loosen and secure all the roots possible, they are packed in damp and partially rotten straw, proper receptacles being at hand so that the roots are not exposed by carrying them any distance. In taking up, all roots bruised by the spade are cleanly cut with a sharp knife. The taproot is cut away at a depth of a foot or so from the surface. This use of wet straw if faithfully carried out will answer well in taking trees short distances for planting, but the use of a puddle on the roots before packing in damp straw gives additional assurance of success.

PUDDLING THE ROOTS.—This method is also used for deciduous fruit trees, as mentioned on page 148. It consists in having a thin pudding of loamy soil with preponderance of sand rather than of clay, into which the roots are dipped as soon as the tree is lifted from the nursery. This mixture, which should be about as thick as cream, may be made in a hole in the ground, or, better still, in a box or cask large enough to allow complete plunging of the roots. As soon as dipped, and with all the mud which will adhere, the roots are packed in wet straw. If the trees are to remain thus packed for any length of time, the greatest care must be observed to keep the straw damp, and water must be applied gently to avoid washing the puddle from the roots.

SACKING THE ROOTS WITH A BALL OF EARTH.—This is a very satisfactory way to move orange trees, and if it is well done, the tree does not wilt, and may be moved long distances

and handled more freely than the puddled roots. To ball and sack trees, dig a trench along one side of the row about six inches away from the trees, and about a foot and a half deep. By careful digging under each tree from this trench the taproot is reached, and severed by a cut with a sharp spade. The side roots are also cut by thrusting the spade down on the three sides not opened by the trench. The top earth is carefully removed nearly down to the highest lateral roots, and after being sure that the roots are severed all around, the tree is lifted out with the ball of earth which incloses the remaining roots. This ball is rounded off carefully and then placed on a half of a grain sack or other piece of burlap, the corners of which are drawn up and tied around the stem of the tree with baling rope. It is also an additional surety of safety to allow the baling rope to run under and around the ball to aid in holding it together. The balled trees must be carefully handled so as not to break the ball, which would result in tearing to pieces, as well as exposing, the roots.

The manner of handling the trees depends somewhat upon the character of the nursery soil. Successful balling of course requires a certain amount of adhesiveness in the soil.

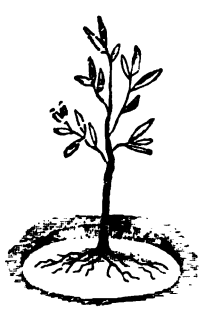
One cannot be too careful in the handling of orange trees. Mr. Garey well remarks: "The orange tree is one of the hardiest trees known; will survive very harsh and unhorticultural-like treatment; it will withstand drought and excess of water; it will live and make a stunted growth, with slovenly cultivation, when what are called our hardy trees would die. At the same time the whole of the citrus family responds most gratefully to proper treatment." Though this is true of the tree when in permanent place, it must be most carefully transplanted. Lifting from the nursery when the soil is too dry, exposure of the roots, or careless planting, will consign the tree to a slow, sickly growth, and often kill it outright.

CUTTING BACK AT TRANSPLANTING.—The rule of reducing the top to compensate for the loss of roots, is vital in moving orange trees. Some growers cut back the young trees a little while before lifting from the nursery. Some take off all leaves after planting out, and claim that growth starts sooner and more strongly.

DIGGING HOLES AND SETTING TREES.—The same considerations which require extra care in lifting trees for nursery, rule in placing them in permanent place. All authorities on the subject specify exceptional care in preparing the tree holes as a profitable investment on the part of the planter. Large and deep holes are commended. Digging very deep and filling in

the bottom of the hole with bones, or with well-rotted manure, to which wood ashes and lime are added, has proved profitable when proper materials are at hand, but if they are placed in the bottom of the hole, they must always be covered with clean soil, so that the roots may not come into immediate contact with them. As to digging deep holes, they would be more injurious than beneficial in a tight subsoil, but there is little use in putting oranges on such a subsoil unless blasting is done, as described in Chapter XI. There are good orange trees now bearing in such places—good enough at least to be an ornament and acceptable fruit producers for family use.

In preparing holes for orange trees, Mr. Lelong advises the excavation of a hole as large as the spread of the roots will extend, filling the hole with good top soil so as to form a mound in the center; in the center of the mound a hole is made with the shovel handle, into which the tap-root of the tree is placed, the laterals being evenly extended and arranged upon the slanting surface of the mound, as shown in the engraving. Over the roots thus arranged surface soil is thrown and the whole lightly tramped. Then water is used and the earth compacted around the roots by water settling. After the water has settled away, the hole is filled and the surface left loose to prevent evaporation.



SPREADING ORANGE ROOTS IN PLANTING.

There are very elaborate methods of tamping and tramping of the soil about the roots, described by different growers. The aim is the same in all cases, viz., to secure close contact of the roots with the soil at all points. This is essential, and there may be many different ways of attaining it.

These instructions apply to the planting out trees which are taken up with long roots and puddled. In planting out balled trees, the sack is not removed, but after the tree is embedded in the earth, the tying rope is cut. The sack soon decays in the soil.

Orange trees can be successfully transplanted at different times of the year, but the best time is after the ground gets well warmed by the spring sunshine. The date at which this condition arrives depends upon locality. Experience seems to indicate that the young orange tree is in best condition to transplant just as the new growth is starting out, and preferably when it has not grown out more than two inches.

Great care must be taken that transplanted orange trees do not become dry after planting. The methods of irrigation are described in Chapter XV.

DISTANCES IN PLANTING.—Distances for planting orange trees are governed by the habit of the varieties. Mr. Lelong gives the following table:—

Dwarfs, such as Tangerine, Satsuma, etc	10 feet
Semi-dwarfs, such as Washington Navel, Mediterranean Sweet, Maltese Blood, and St. Michael	18 to 24 feet
Standards, such as Wolf-kill's Best, etc	24 to 30 feet
Seedlings	30 to 40 feet

PRUNING ORANGE TREES.

The best form of tree is a low-headed, compact growth, something as shown by the accompanying engraving from Mr. Lelong's treatise. It is secured by trimming the young tree at transplanting to a straight shoot of four to six feet in height and tying it to a stake to give it support and straightness. All shoots from above the bud are permitted to grow to shade the trunk and to stiffen it, though a too strong lateral may be pinched. The trunk must be protected from the sun by wrapping with paper or something of the kind, until the leaves do that service. The lower branches will bear the first fruit, and as the tree attains age they will stop growing and can be removed. Thus the head of the tree is raised gradually, and space is given for the drooping of the higher branches. In the top of the tree, too, the rule for pruning should be to remove the weaker branches which seem to have outlived their usefulness, and thus give more room for the vigorous ones. The principle which should govern in this matter, as well stated by Mr. Sallee, is given at the top of page 168, in the general chapter on pruning.

DESIRABLE FORM OF ORANGE TREE.

High heading is practiced by some growers, as shown by an adjacent engraving. It is open to the general objection to high heading. The objectionable form of tree reached by thinning out of the head is also shown, both engravings being borrowed from Lelong. The natural form of the orange tree is undoubtedly superior so long as the tree is not persecuted by pests, and is in a situation where natural conditions favor it.

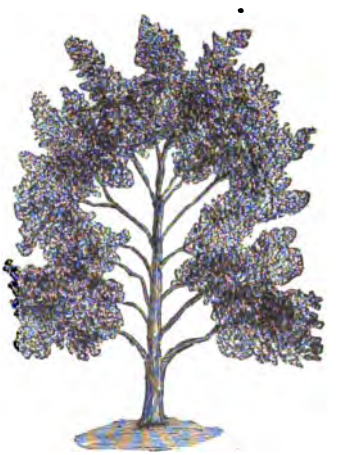
When it is beset by evils, its treatment may have to be changed to aid in conquering them.

DISEASES OF THE ORANGE.

A HIGH-HEADED TREE.

The orange is thus far subject to few diseases in California. The gum disease at the root-crown, which gave much cause for complaint some years ago, was found to be largely due to immediate contact of irrigation water with the trunk, and was reduced by preventing such contact. But all gumming is not due to this cause. When it occurs either on trunk or limb, the remedy is to cut away the diseased bark and gauge out the wood beneath until sound white wood is reached, and then cover the wound with a plaster of cow manure and clay, or paint over with some protecting material, for which Mr. Lelong commends rubber paint as best.

There are several serious insect enemies of the orange, which will be mentioned in the chapter on that subject. The "black smut," which makes leaves and fruit unsightly in some parts of the State, is a fungoid growth upon the exudations of insects, and can be prevented by removing its cause.



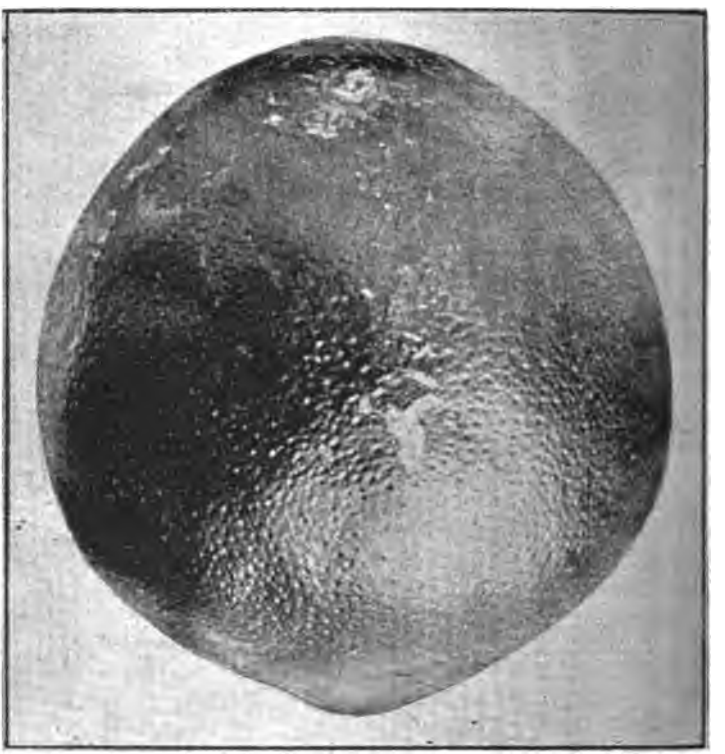
RESULT OF THINNING OUT.

VARIETIES OF THE ORANGE.

Though many varieties of the orange have been introduced in California, but few are generally grown. A considerable part of the product is from unnamed seedlings, but the prices which the improved varieties command in the market are constantly increasing the proportion of budded sorts. The hardiness of California seedlings, which makes them profitable where some foreign varieties fail, and the greater size which the tree attains, lead some growers to maintain the superiority of

seedlings. The practice prevails to some extent of planting seedling and budded varieties in alternating squares, as stated on page 126, and this gives the planter the advantages of both classes of trees. The question about the superior longevity of seedlings must be left to the future to determine. California experience has been too short to warrant conclusions.

At the South the suitability of certain varieties has been well ascertained; in the newer orange regions at the North, ex-

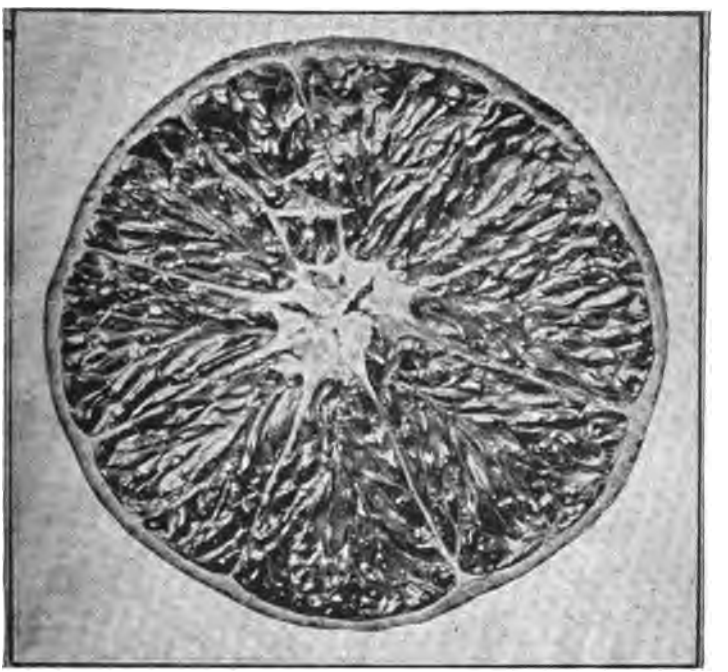


NAVEL ORANGE GROWN BY A. C. THOMPSON, OF DUARTE.

perience has not proceeded far enough with budded varieties to determine which will best answer local requirements. The following descriptions of the varieties now most popular in this State are, for the most part, condensed from Mr. Lelong's publications, and from the same source most of the accompanying illustrations are also derived.

WASHINGTON NAVEL (*Bahia, Riverside Navel*).—This orange is the most popular of all foreign varieties grown in this State. Fruit large, solid, and heavy, skin

smooth and of a very fine texture; very juicy; high flavored, with melting pulp; is nearly seedless, only in exceptional cases are seed found; tree is a good and prolific bearer, medium thorny, a rapid grower, although it does not attain a very large size; bears when very young, commencing to bear as early as one year old from the bud; ripens early. This variety was imported from Bahia, Brazil, in 1870, by Mr. W. Sanders, of the Department of Agriculture at Washington, and in 1874 two trees were received from Washington by Mrs. Tibbetts, of Riverside, Cal. Trees were also received about the same time by Alexander Craw, but the Riverside trees were first in fruit, and the excellence of the variety being at once recognized, it was propagated rapidly and took the name Riverside Navel from the place where its characteristics were first made known. A. S. Chapman says: "The Washington Navel is the finest of all the budded varieties, and sells for more money, but the tree does not grow nor



CROSS SECTION OF NAVEL ORANGE GROWN BY A. C. THOMPSON.

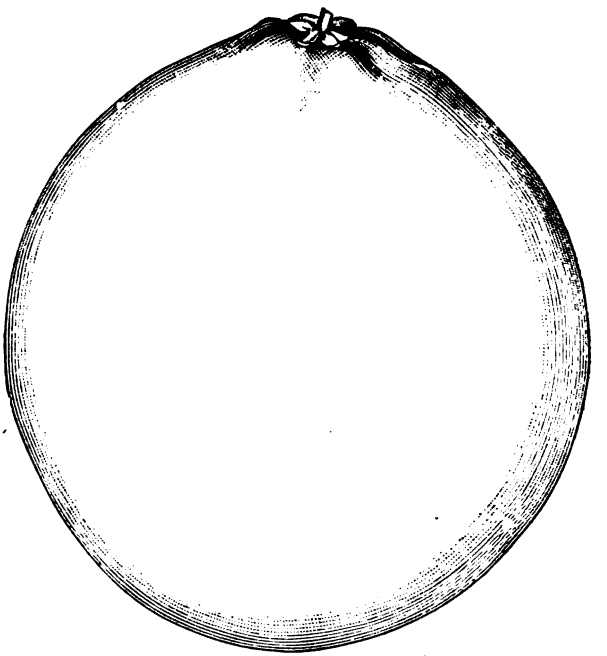
bear well except under the most propitious circumstances, and the fruit is very susceptible to frost."

A. C. Thomson, of Duarte, Los Angeles County, has produced an exceptionally fine type of the Washington Navel, which he claims is a sub-variety, produced by a process of propagation, which he does not disclose, but whether the excellency of the fruit is to be attributed to his method or to the exceptionally favorable soil and climate of his location, or whether he has merely a natural variation of especially good points, is not fully established.

AUSTRALIAN NAVEL.—This tree does not resemble the Washington Navel in its habit; the foliage does, however, and in this way its identity has been much mistaken. The fruit varies greatly in size, all sizes generally being found on the same tree. A very shy bearer. Blooms profusely, but very few of the blooms set; often the trees are loaded with fruit, and after having attained the size of marbles drop to

the ground, without any apparent cause; fruit also has a tendency to split at the navel, which is usually large and prominent, unlike that of the Washington Navel, which is round and generally small. This variety was introduced from Australia, by the late Lewis Wolfskill, in 1874.

VALENCIA LATE (*Valencia August, Loretto, River's Late*) has fruited for eight years in this State, and is one of the best varieties grown. The trees do not begin to bear as soon as some other budded sorts, which is much in its favor, as most budded foreign varieties bear too soon, and thus check the attainment of proper size by the tree. The orange is also very late in ripening, so that it can be shipped after other varieties are gone. The Valencia Late resembles the Paper-skin St. Michael in color and firmness, but is oblong and larger, as the engraving shows. The Valencia Late has sold at the East at very high prices.



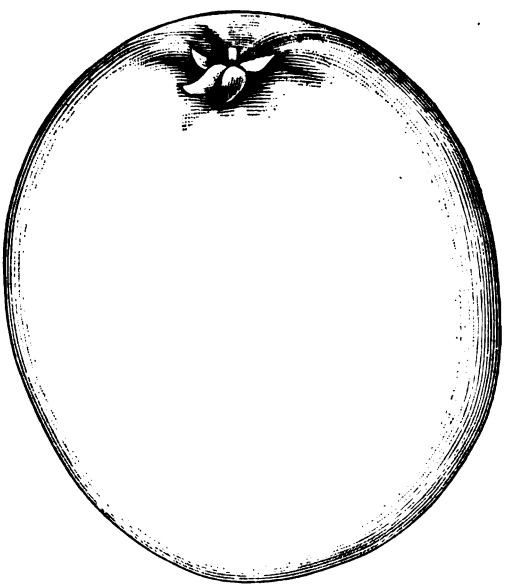
VALENCIA LATE.

MALTESE BLOOD.—A popular variety. The fruit is small to medium; oval and has fine texture and flavor. The pulp is streaked and mottled with red. It has few seeds. The tree is thornless and of dwarf habit, and may be planted closer than freer-growing kinds. Mr. A. B. Chapman, of San Gabriel, is the largest grower of Maltese Blood, and he regards it as one of the best varieties he has. His shipments to Eastern markets have brought large returns. Mr. A. S. Chapman says the Maltese Blood is hardier than the Washington Navel, and the tree a more generous bearer.

MEDITERRANEAN SWEET.—Fruit medium to large, pulp and skin of fine texture, very solid and few seeds; ripens late, often not until May or June. The tree is thornless and of dwarf habit of growth and is inclined to overbear. It is perhaps the most widely-distributed variety in the State, next to the Washington Navel. It was introduced and named by T. A. Garey, of Los Angeles.

PAPER RIND ST. MICHAEL.—Fruit small, round, very firm and very juicy; pale, thin skin, and being very uniform in size packs well. It ripens late, and keeps well on the trees as late as August in Southern California. It does not drop at maturity. The tree is of dwarf habit, medium thorny, a good bearer, and very desirable. It is a great favorite in the San Francisco market.

RIO.—Fruit and tree resemble Mediterranean Sweet; but the fruit is much larger, has a thicker skin, ripens late; very seldom can the entire crop be picked from the tree, as it does not ripen evenly; green oranges are found on the trees throughout the summer. The tree is distinguished from the Mediterranean Sweet by the growth of long shoots resembling water sprouts, which start from the side limbs as well as from the leader. At the tops of these shoots numerous lateral branches put forth, forming a large head, clear above the main mass of foliage; the tree is thornless, or nearly so, and is of a dwarf habit.

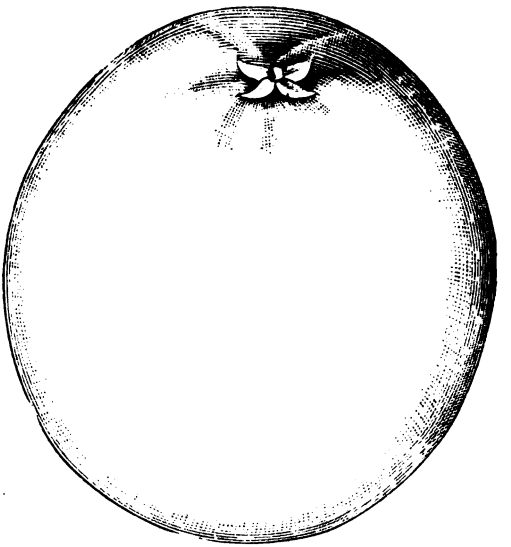


MALTESE BLOOD.

ASHER'S BEST.—Named by Southern California Horticultural Society, for J. M. Asher, of San Diego, who imported the tree expecting to get a Shaddock, but proved an excellent orange when it came into fruit; growth of tree much like Mediterranean Sweet; fruit medium to large; rind very thin; juicy, sweet, and with few seeds.

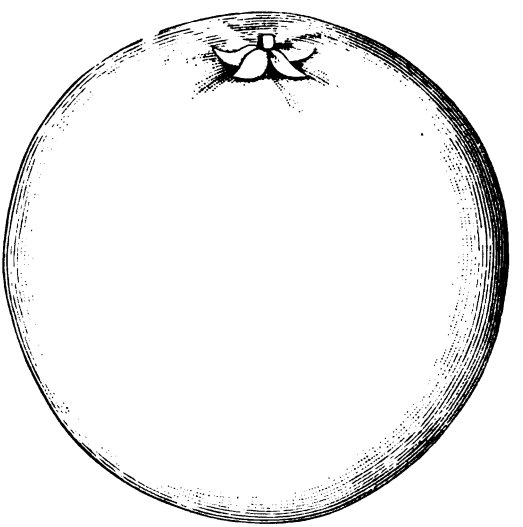
AZOREAN ST. MICHAEL.—Imported by Mr. Chapman, of San Gabriel; fruit medium to large, and solid; pulp fine and melting; medium thin rind, flattened, few seeds; ripens early and keeps well on the tree; a rapid grower and a prolific bearer; is a large tree, and is recommended for standard purposes. This variety has fruited with Mr. Chapman for a number of years, and is considered by him very desirable and profitable.

KING ORANGE.—Imported from Siam by Dr. S. R. Magee, of Riverside, and fruited first by J. E. Cutter, of the same place; fruit ripens late, in May and June;



MEDITERRANEAN SWEET.

below medium size; very rough rind; segments cleave when fully ripe; very high flavor, but unattractive in appearance, both in fruit and tree, which is exceedingly thorny, resembling a lime.



PAPER RIND ST. MICHAEL.

LARGE ST. MICHAEL.—Does not resemble the Paper Rind St. Michael in the least. The fruit is large and very coarse; tree thorny; inferior.

SMALL ST. MICHAEL.—Not an established variety. It is entirely distinct from the Paper Rind St. Michael; fruit small; thick, coarse skin; inferior.

DUROI.—Fruit small to medium, firm, ribbed seeds, and a few thorns. It has not proved valuable in this State. Said to do well in Florida.

THE JOPPA ORANGE—A CALIFORNIA SEEDLING.

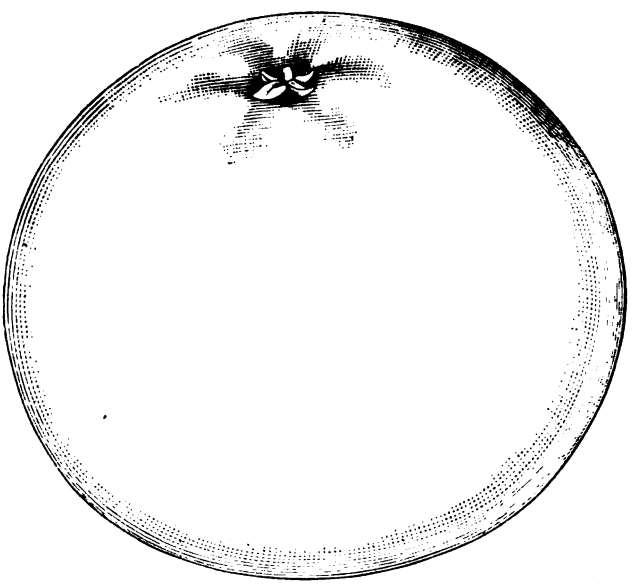
LEADING CALIFORNIA SEEDLINGS.

WOLFSKILL'S BEST, OR FAVORITE.—Originated by J. W. Wolfskill, of Los Angeles. A good grower. Original tree now stands over thirty feet high, and as large as any seedling of the same age. The original tree is not very thorny. Thorns decrease in size as the tree grows older; fruit is of excellent quality, somewhat

flattened, deep orange red, fine grain and pulp; a good bearer; early, and should be picked before May. Ripens ahead of all other native varieties; is largely cultivated in this State; the choicest of all native varieties.

THE JOPPA.—Grown by A. B. Chapman, of San Gabriel, from seed obtained in 1877 from the United States Consul at Joppa, Palestine; named by B. M. Lelong. Fruit large and of red orange color, firm, nearly seedless, thin rind, pulp very fine, sweet and juicy; tree thornless, upright, and vigorous grower, suitable for standard purposes. Commended by the Chapmans and Colonel Dobbins, of San Gabriel, as one of the best oranges grown in California; ripens reasonably early, but its remarkable characteristic is that it can be left on the trees as late as July and yet retain all the features of a sound first-class shipper. Should not be confused with the Jaffa, a dwarf variety introduced from Florida.

MAYBERRY'S PREMIER.—Originated by E. L. Mayberry, at El Molino Ranch, near San Gabriel. The original tree (a twin tree) stands about thirty feet high.



WOLFSKILL'S BEST—A CALIFORNIA SEEDLING.

The orange is medium in size, but of a deep red color; rind thin and very smooth; pulp and grain very fine. The old tree has very small thorns. Budding appears to improve the growth of the trees. Spring buds generally make large trees the first year. This variety should be budded on thrifty stalks, able to hold the weight of the bud after a year's growth.

BALDWIN'S FAVORITE.—Originated by the late Lewis Wolfskill at the Santa Anita Ranch, Los Angeles County. It is a good seedling, but lacking qualities which the two varieties above mentioned possess.

WILSON'S BEST (*Lake Vineyard*).—Originated by the late B. D. Wilson, at San Gabriel; a good variety. Original tree is very large and quite thorny.

KONAH.—A California seedling from seed grown on Konah Island. Fruit large, rough, and thick skin; tree very thorny and very hard to keep in shape; ripens early, and is considered by many to be a very desirable variety, better in some localities than in others.

COOPER'S SEEDLING.—Originated by Hon. Ellwood Cooper, at Ellwood, Santa Barbara County. Fruit of medium size, oval; pulp very fine and melting; color pale yellow; very thin skin; seedless; a thrifty grower, and a prolific bearer; a very desirable variety.

KERCHEVAL'S QUEEN.—Originated at Los Angeles. Fruit above medium size, excellent flavor, few seeds, and medium thin rind. The tree is a vigorous grower.

JAPANESE VARIETIES.

TANGERINE, OR KID GLOVE.—Several varieties are grown under this name, the Japanese names having been lost. The largest growers are the Chapmans, of San Gabriel, who have had excellent results from budding the Tangerine high up in standard trees, thus providing for the weeping habit of the Tangerine. The fruit grown by them is deep red, small; rind separating readily; very sweet.

SATSUMA (*Unshiu, Oonshiu*).—A large acreage of this variety has been recently planted; tree thus far quite hardy, fruit irregular in size, but usually medium size, flattened; rind easily detached; fine texture, sweet and nearly seedless.

KINCQUAT (*Citrus Japonica*).—Fruit very small, oblong or olive shaped, rind thick, yellow, smooth; sweet-scented; very little pulp; containing many seeds; tree dwarf (a bush), a prolific bearer. The fruit is edible whole, also valuable for preserves and marmalade.

CHAPTER XXXII.

THE LEMON, LIME, ETC.

THE lemon product of California is very small. The tree is less hardy than the orange, and is otherwise more exacting in its requirements. For this reason it is probable that a much smaller area of California is adapted to the commercial production of the lemon. The fruit also has a grievous competitor in the imported Sicily fruit and the popular favoritism for it, which, like many other popular fancies, amounts to a blind prejudice. There is, however, reason for the preference for the imported fruit, when one considers only the relation of the common California seedling lemon to the Sicilian fruit, for the common California seedlings are very poor, overgrown, and coarse, deficient in acid, and full of bitterness, prone to decay even when fairly handled. But when the comparison is drawn between a few improved varieties, which are now quite largely produced and properly cured by a few enterprising growers, California lemons have nothing to fear from the imported fruit, except the popular prejudice for the imported, which is so unreasonable that it condemns without trial. Still there is progress being continually made by the few growers who have confidence in the home product, and intelligence and diligence to properly prepare it for marketing, and find the fruit very profitable. It now seems assured that the next few years will bring California-grown lemons into better repute and larger supply.

SITUATIONS AND SOILS FOR THE LEMON.

The lemon requires a practically frostless situation. Such places are found in largest area in the southern half of the coast regions of California, but also exist at favoring elevations in the interior. The moderating influence of proximity to salt water, and the effect of local topography and environment, which give frost-free nooks or belts, are elements favoring the lemon grower. In such situations the lemon blooms and fruits continuously throughout the year.

While the lemon requires a less extreme of low temperature than the orange, it also thrives with a less extreme of high tem-

perature and less duration of it. It apparently does not require as much heat to develop acid, which is the charm of the lemon, as it does sugar, which is essential to an acceptable orange; therefore, a coast situation which may not yield a sweet orange may produce a good lemon. Another advantage of the lower summer temperature is that the continuous ripening is not interfered with, as it is by high summer heat, which hastens maturity and brings the mass of the fruit to marketable condition in the winter—a season when the demand for the lemon is very small. This objection is, however, being clearly overcome by the proper storage and treatment of the fruit for sale, at a considerable interval after picking, as will be mentioned presently.

The lemon delights in a sandy loam, and probably our best orchards are on such soil, but the trees thrive in other soils. There is a difference of opinion among growers as to what soil is to be especially sought for. There are profitable lemon orchards in Southern California located upon deep clay loams, and even upon strong red clay soils. As with some other fruits, the choice of soil is, to a certain extent, governed by the stock on which the lemon is worked.

PROPAGATING, PLANTING, PRUNING.

The prevailing stock for the lemon at present is the orange seedling, though there are still some advocates of the lemon root. The orange root thrives on a greater variety of soils than the lemon, and produces a healthy lemon tree where the lemon on its own root would fail. The growth of orange seedlings for budding has been described in the last chapter. Lemon seedlings are grown in the same way. Plants either for permanent growth or for stocks for budding can be grown from cuttings. Cuttings should be of moderate size, of well-hardened wood. They should be of the last growth, taken when the tree is dormant, and should be planted when the ground is warm, and kept moist, but not wet. The budding of the lemon is practically the same as of the orange, which has been described. An old tree can be changed from one variety to another by cutting back in the spring, and budding in the fall, into the young wood, which grows freely from the stubs of the renewed limbs

Planting of the lemon is the same as that of the orange. The distance in planting varies from twenty to twenty-five feet. Irrigation of lemon and orange trees is also similar.

Pruning the lemon consists chiefly in forming the young tree, and in this effort pinching overgrown shoots will save much cutting afterwards, and will check the running out of straggling branches, a habit of growth to which the lemon is quite prone.

Trimming out the head by renewing weak shoots is also sometimes desirable. Low heading of lemon trees is altogether desirable.

PREPARATION OF LEMONS FOR MARKETING.

The lemon as taken from the tree is not in condition for marketing. To secure best results in quality and in keeping properties, the lemon should be carefully cut from the tree as soon as the faintest approach of the yellow color is discernible. To allow the fruit to hang upon the tree until full lemon color is assumed, gives a lemon which is deficient in juice, oversized, apt to develop bitterness, and prone to decay. If gathered as the color begins to turn, lemons may be kept for months, and they will improve in market qualities, by a thinning and toughening of the skin, and by increase of juice contents. This curing of the fruit, as it is called, is accomplished in many simple ways. If the fruit is gathered and placed in piles under the trees, where, with low-headed trees, it is completely shaded by the foliage, it progresses well and comes out beautiful in color and excellent in quality, providing it is a good variety. Some have trusted wholly to this open-air curing under the trees, merely protecting the fruit by a thin covering of straw, or other light, dry materials. Others let the fruit lie a few days under the trees, carefully shaded from the sun, and place it in boxes or upon trays, and keep it months in a darkened fruit-house, guarding the fruit against draughts of air. Gathering the fruit while still green, and packing with alternate layers of dry sand, has given excellent marketable fruit, but of course the handling of so much sand is somewhat objectionable. The methods and facilities employed by N. W. Blanchard, of Santa Paula, Ventura County, yield very satisfactory results. They are as follows:

The lemons are stem-cut, and are gathered by taking all, without regard to color, that will not pass through a two-and-one-quarter-inch ring. During the more active ripening season, the lemons are gathered as often as once a month; for instance, the orchard was picked early in January, again early in February, and again early in March, and the picking was not then finished—indeed, there is scarcely any month that I do not have lemons to gather. I thus prevent having any very large lemons, unless they are overlooked. The lemons are handled carefully, hauled at once from the orchard, washed from a tub of water with a brush, for we have some smut, placed one layer deep in trays, two by three feet and three inches deep. These trays are slid into a rack for the lemons to dry and wilt for one, two, or three days in the shade. They are then piled in the curing-house, one across another up to the ceiling.

The curing-house is a two-story building on the north side of, and under, tall blue gum trees. The lower story is made double-walled, the walls a foot apart, filled between with sawdust, with an inner and outer door. From this lower story a ventilating flue, sixteen inches square, runs through the ceiling and upper story and roof. The lower story is divided into compartments, the object being to keep the room cool and dark, and to avoid a circulation of air. The more the doors are open, or the more air circulating around the lemons, the more rapidly the curing goes on. I

can prepare my lemons for market in two or three weeks, or keep them several months. I do not know how long they may be kept without becoming too soft, for I have not yet had time to sufficiently experiment. I have a little over nine hundred bearing trees, from which I sold, in 1889, two thousand five hundred and forty boxes of lemons, and at the same time my crop was considerably injured for the first time by the severe local frost of January 17 and 18, 1889.

There are other methods which yield good results, and there is still room for experiment. By skillful handling it seems quite certain that the fruit may be gathered early in the winter, and kept for marketing the following summer, for the winter demand for lemons is small.

VARIETIES OF LEMONS FOR CALIFORNIA.

The best lemons, according to present experience, are of few varieties, part of which have been introduced, and part are of local origin. The following are the varieties now most popular, as described by Mr. Lelong:*

LISBON.—Imported from Portugal. Fruit uniformly medium size, fine grain, sweet rind, very strong acid; very few seeds; a good keeper, can be picked at any time of the year. The tree is a strong grower, prolific bearer, and makes a larger tree than other varieties; quite thorny, but thorns decrease in size as the tree grows older. A very desirable variety.

VILLA FRANCA.—Imported from Europe. Is of a medium size, considered to be the finest of all lemons grown; has fruited in Los Angeles for several years in the orchard of J. W. Wolfskill. Fruit oblong, slightly pointed at the blossom end, rind thin, without any trace of bitterness even when green, acid, strong, juicy, nearly seedless. Tree thornless, branches spreading and somewhat drooping, foliage abundant to protect the fruit from the sun; said to withstand a lower temperature than other imported varieties.

GENOA.—Imported from Genoa by Don José Rubio, of Los Angeles. Medium size, oval, sweet rind, thornless, and nearly seedless. Tree is of a dwarf habit, a good keeper, one of the best.

ASIATIC.—Imported by J. W. Wolfskill, of Los Angeles. Fruit medium size, oval, thin rind, without any trace of bitterness under the most careful tests. Tree and fruit resemble the Genoa, but a better acid; thornless.

SICILY.—This lemon was about the first cultivated in California. Since then many other varieties have been introduced which are far its superior. However, if put through the proper treatment, will produce a good lemon.

EUREKA.—A native of California, originated by C. R. Workman, at Los Angeles, from seed imported from Hamburg in 1872, only one seed growing, from which buds were put by him on orange stock. Distributed by T. A. Garey, of Los Angeles. Fruit medium size, sweet rind, a very good keeper, and very popular, more so than any other variety. The drawback it has is that the leaves are inclined to curl, scarce foliage, fruit produced at extremities of branches and liable to get sunburnt; but this is generally avoided by letting the branches hang low, and pruned as little as possible.

AGNES.—Originated at National City by Mr. Frank A. Kimball; of superior quality, medium size, sweet rind, pulp very fine, with strong acid and very few seeds;

*"Citrus Culture in California."

thorns few, short, and blunt; is a rapid grower, but drooping in character; medium dwarf. This lemon has fruited for six years with Mr. Kimball, and has proved itself to be a good keeper and a very desirable variety.

OLIVIA.—Originated by George C. Swan at San Diego. Fruit of medium size, and said to be of excellent quality; strong acid, and a good bearer; thorny.

GARCELON'S KNOBBY.—Originated by G. W. Garcelon at Riverside. Fruit of medium size; when cured very thin rind, juicy, and the tests have found it to contain more citric acid to its size than any other lemons.

BONNIE BRÆ.—Originated with H. M. Higgins, of San Diego County, and profitably grown by him for many years.

THE LIME.

The lime has proved much less hardy than the lemon. It has been killed in situations where the orange and lemon have not been injured. Unless adequate protection is thought worth the effect, there is little use in planting the lime, except in a frostless situation. Such localities are found near the ocean in Southern California, and here and there at proper elevation in the interior, but the growth of the lime must be counted very hazardous. There is less inducement to experiment with the fruit from the fact that the Pacific Coast markets are well supplied with Mexican limes, usually at prices which leave no opportunity for competitors.

Limes are grown from seed, the variety usually coming true from seed. The trees are small and are frequently grown in hedge form. The common variety is the Mexican. Mr. Lelong mentions a hardier sort, which should be given wider trial, as follows:—

IMPERIAL.—Imported by J. W. Wolfskill, of Los Angeles; the largest of all limes; the size of the Genoa lemon. It is quite as hardy as the lemon; can, therefore, be planted where the Mexican lime would be sure to fail. The tree is very productive, fruits all the year round, and is less thorny than the Mexican lime.

THE CITRON.

This fruit is little grown in California, although it is quite hardy and could be produced over a large area. The only use for the fruit is in its candied rind, and no one has deemed it worth while to push competition with the imported candied citron, though very fine experimental lots have been produced, and the interest of the fruit-preserving establishments in the product recurs periodically. In 1890 there were collections of citron trees imported from the Mediterranean region by the United States Department of Agriculture planted at several points in Southern California. Mr. Lelong gives the following note:—

CITRUS MEDICA CEDRA (Citron of Commerce).—Shape oblong like the lemon, with a very pleasant aroma, which is much esteemed; skin bright yellow, smooth and very glossy; inner skin white, coarse, and thick, with very little trace of bitterness; the fruit grows very large, weighing from three to five pounds each. The tree is of a dwarf habit, with large, glossy leaves and very ornamental. It grows from the cutting, and is also budded on orange, lime, and lemon stock. It comes true from seed.

ORNAMENTAL CITRUS SPECIES.

There are grown in this State for curiosity or ornament various minor citrus species, including the dwarf ornament sorts from Asia, and the mammoth fruited kinds, the Pomelo, Shaddock, and Bergamot. These large fruits, which, in the case of the Pomelo, attain a weight from two to five pounds, are used for decorative purposes. There are, of course, the ornamental species grown by florists for their fragrant bloom.

CHAPTER XXXIII.

MINOR SEMI-TROPICAL FRUITS.

A NUMBER of interesting fruits are now grown in this State which, for one reason or another, have not attained any great commercial importance. Some of them are quite likely to advance in popular esteem and to gain a higher place in the markets. Others will probably never be grown except for home use and garden ornament. Two interesting papers* have recently been written on these rarer fruits of California, and free use will be made of the facts therein stated, in connection with other data which the writer has collected. The arrangement will be in alphabetical order, and, though some of the growths should properly be classed as tropical, they will be presented in one group for sake of convenience.

THE BANANA.

The banana has been a favorite plant for experimental culture for many years, and though good fruit has been grown at various points in the State, the culture is too hazardous to warrant large investment, and if this danger was not present, the abundant supplies available from the islands of the Pacific would probably reduce the profits to a narrow margin. About twelve years ago there were experiments on quite a large scale in Los Angeles County, but the low temperature which has been occasionally reached since that time seems to be a warning that the banana can be trusted only in protected situations and in small numbers which can be given special attention. With these conditions the banana may yield very acceptable fruit for home use and be an ornament to the garden. Its beauty is, however, seriously impaired by winds which whip its tender leaves into shreds and give the plant an unkempt appearance.

The largest number of bananas are seen in Los Angeles and Santa Barbara, and one grower at an elevation near the latter place reports his table supplied daily throughout the year with

*"Tropical and Semi-Tropical Fruits of California," etc., by W. G. Klee, Bulletin I, Division of Pomology, U. S. Department of Agriculture 1888.

"Rare Fruits of the Santa Barbara Region," by Professor H C. Ford, Report American Horticultural Society. Vol. V. W. H. Ragan, Greencastle, Ind., 1888.

the fruit of the Cavendish species. Mr. S. H. Gerrish, of Sacramento, has made a specialty of the banana for a long time in his city garden. He gives the following note on varieties and suggestions as to culture on a small scale:—

The varieties planted here have been the Florida "Hage," "Narse," or "Orinaka," called by Spaniards "El Babo," the fool. It is a splendid-looking plant, but produces inferior fruit. This variety has been planted largely all over the State. As it will stand anything, it is a great success as an ornament. Other varieties have been tried, but from causes have failed to succeed well. The *Cavendishii*, a splendid variety, growing only six feet high, bears a larger number than most varieties and matures early, but it would not do. The Dacca was too tender. The *Musa Rosacea*, the banana which produces the manilla hemp, does well, is a great ornament, but the fruit amounts to nothing. The only variety I have seen producing fruit in this State fit to eat is the Martinique or Yellow Costa Rica. It is a beautiful plant, grows sixteen feet high, bears well, grows rapidly, stands the winters, the fruit is superior, four inches long by an inch and one-half in diameter, of a clear, golden yellow, soft kid-glove-like texture of rind, firm, soft, buttery, melting, sweet pulp of an aromatic vinous flavor.

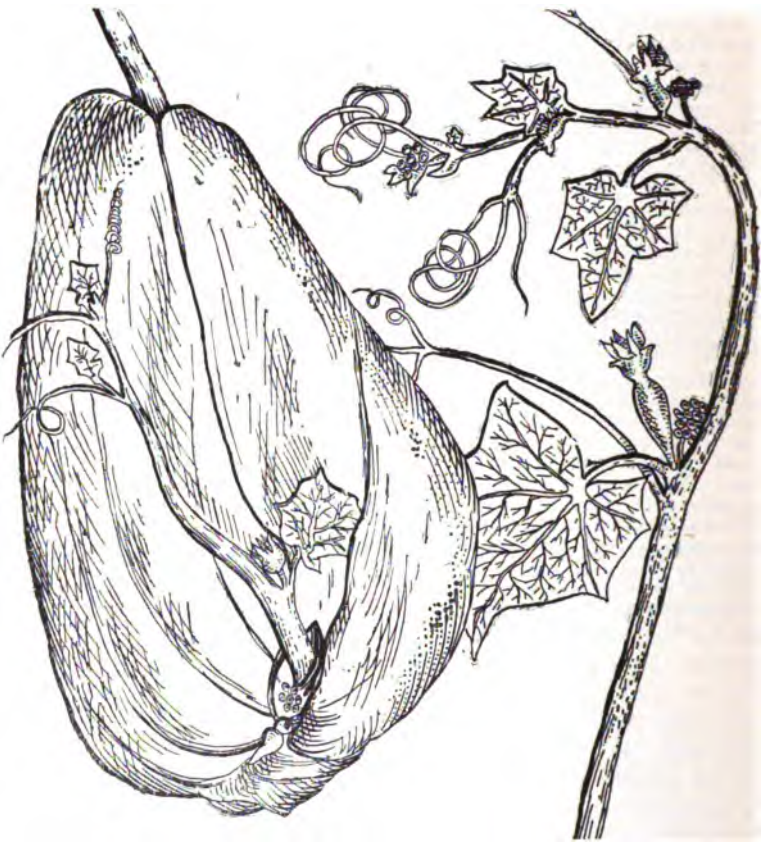
By experiment I have found that the banana will live—if in a proper soil—without injury to the roots, at a temperature as low as sixteen degrees Fahr.; the stalk will stand a temperature of twenty-five degrees without injury, and the leaves are not wilted until the air is chilled to thirty degrees. This is with the thermometer placed near the plants, or at an elevation of five feet from the ground. As this plant is a native of the hot tropics, where there is an immense rainfall, it is necessary here to produce like conditions; a soil must be created with conditions similar. This can be easily done. My method has been to supply the richest food for this gigantic plant and force it to its extreme growth. Everyone has old chip dirt, ashes, boots, shoes, clothes, and manure, which are often a nuisance. Dig a big hole, bury this up, in the center of the mass place a pailful of sand, and plant the fresh bulb. This is to preserve the dormant plant from the wire-worms and insects, which will not attack the growing plant. As the plant grows, give it an abundance of water and all the slops of the house. Any kind of manure, fresh or old, ashes, leaves, and vegetables, will soon disappear and be absorbed by this gigantic king of plants. As the rainy season approaches, pile all the leaves and twigs of trees around the plants. It protects the bulbs and makes the soil rich for next season. It is a very easy plant to cultivate. Never try to protect it by covering in winter, for it makes the plant weak. My experience shows me that it is more than useless.

THE CHERIMOYER OR CUSTARD APPLE.

The oldest cherimoyer (*anona cherimoya*) is growing in Santa Barbara. According to Professor Ford, the fruit was introduced about twenty-seven years ago, and the parent tree, now standing on the grounds of Mr. A. Packard, has attained its full height of sixteen feet, and has produced abundant fruit for many years in such perfection that the seeds have readily germinated, and trees thus propagated have been in successful bearing in several Santa Barbara gardens. The leaves are oval and pointed at both ends; flowers solitary, very fragrant, and having a greenish color. Good specimens of the fruit are three or four inches in diameter, often heart-shaped, grayish brown or nearly black when fully ripe. The flesh, in which thirty or forty brown seeds are found, is soft, sweet, and pleasant to the taste, being most

palatable when near decay. Apparently it has no particular season for ripening, yet the best specimens seem to be found in Santa Barbara in April and May.

The cherimoyer is also found in gardens in San Diego and Los Angeles. It needs a well-protected situation. At Berkeley it was killed by a temperature of twenty-eight degrees Fahr.



THE CHOCHO VINE IN FRUIT IN SANTA BARBARA.

THE CHOCHO OR CHAYOTA.

The Chocho plant is fruiting in Santa Barbara County, for Mr. Kinton Stevens, of Montecito, who obtained the seed from Samoa. *Sechium edule* is the botanical name of this plant, but it is perhaps better known as "Choco," "Chocho," "Chayota," and "Portuguese squash." It belongs to the order Cucurbitacæ, and is a perennial vine, resembling in growth and fruit our

summer squash or vegetable marrow. It is a very prolific bearer. Both the fruit and the great yam-like tuber are used as food by man and beast in the West Indies, where it is considered a wholesome article of diet. The roots often weigh as much as twenty pounds. They have a flavor similar to the yam, and are considered a greater delicacy than the fruit, which in a raw state resembles the chestnut in flavor, and under favorable conditions weigh over three pounds. The engraving used herewith is from a drawing by Dr. L. G. Yates* and shows the way the fruits sprout while growing on the parent plant. The proper way to grow them is to plant the whole fruit, as they have but one seed, and they produce fruit in three months under favorable conditions.

THE GUAVA.

Two species of guava have been quite widely tried in this State—the strawberry guava (*Psidium cattleyanum*) and the pear-shaped guava (*Psidium pyriferum*). The former is the hardier, and, in fact, seems to be about as hardy as the orange, and it has fruited in widely-separated parts of the State; the latter is quite tender, and is at present only grown in favorable places along our southern coast, and even there it is found inferior in quality and usefulness to the strawberry guava. One of the largest guava growers is Hon. T. J. Swayne, of National City, San Diego County, who writes of the fruit as follows:—

Its habit of growth is bushy, but if pruned to one stem will form a low-limbed tree of ten or twelve feet in height (the highest in this vicinity). Its small, white, and very fragrant blossom appears a little later than that of the orange, the fruit beginning to ripen in September, continuing through December, thus giving a long season. The best flavor is found when thoroughly ripe and fresh picked, at which time it is of a dark purple color. The bushes are heavy bearers and when the soil is kept moist by monthly irrigation and a reasonable amount of fertilizer used, if not too overloaded, the fruit will grow to the size of, or larger than, an English walnut. About nine feet is a good distance to set the plants apart; however, they can be set half that space one way and on becoming too close by growth, every other one can be readily transplanted after fruiting, which begins at two years from the seed.

Of the uses of the guava, Mr. S. Whitmore, of San Diego, says:—

When dead ripe, ready to fall off, it is good to eat out of the hand from the bush. It is also good to eat as you would strawberries—with sugar and cream. Slice the fruit, and sugar from two to eight hours before using. Those who have tried them say they make splendid pies. The main use, however, is to make jelly—the finest jelly there is made. This is universally acknowledged, I believe. I honestly think there can be more jelly made from an acre of guavas than from any other kind of fruit, currants not excepted.

The guava grows readily from the seed, and grows from cuttings under glass. In regions of generous rainfall and on re-

* *Pacific Rural Press*, April 4, 1891.

tentive soil it does not require irrigation, but it must have sufficient moisture at command. A light loam seems best adapted to the shrub. It should be more widely grown for home use, and it is likely that the market demand for it will increase as its usefulness becomes more widely known.

THE JUJUBE—GROWN IN SONOMA COUNTY, CALIFORNIA.

THE GRANADILLA.

The granadilla is the term applied to the edible fruit of a species of passion vine *(passiflora edulis)* which is quite hardy, and is growing in different parts of the State. The writer has a vine in his garden at Berkeley which yields a large amount of fruit, which is eagerly eaten by the children. The fruit is about the size of a small hen's egg, purple exterior when ripe, the thin brittle shell inclosing a mass of small seeds covered with a bright yellow pulp, mildly acid, and of very agreeable flavor. Very good jelly has been made of the fruit.

THE JUJUBE.

The jujube (*Zyziphus jujube*), from the fruit of which the

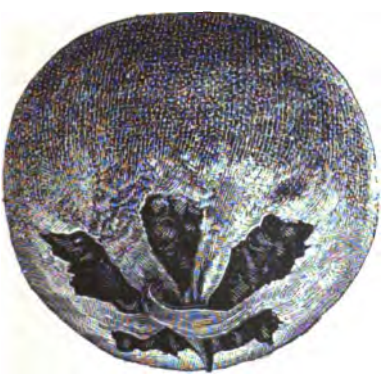
delicate paste of the confectioner is, or should be, made, was introduced by G. P. Rixford in 1876; the plants, obtained in France, were planted in the Sonoma Valley, and are now about ten or twelve feet high, and fruiting regularly and freely. The plant is easily grown from seed or cuttings and has been distributed widely through the State from Mr. Rixford's trees. The orange-red berries are produced three years from planting, and ripen in November and December. They are edible fresh or dried. As yet the fruit has not been turned to commercial account.

THE LOQUAT.

The loquat (*Eriobotrya Japonica*) is widely grown in California as an ornamental plant, and a small amount of fruit is profitably marketed each year. Professor Ford comments upon the plant as follows:—

> It is in blossom in the early winter months, and by March and April the fruit is to be obtained in our markets, where it finds ready purchasers. Ripening at a time when other fruits are comparatively scarce, with its delightful and refreshing flavor, it promises to become still more popular. Efforts are being made to introduce a new variety from Japan that is said to be much larger in size than now planted, having more pulp, with smaller seeds. Belonging to the Pomaceæ, it may be grafted on any species of this genus. The long, dark green, and rigid leaves, the deliciously fragrant flowers, and the golden clusters of fruit, render it a favorite in our ornamental planting. The fruit will bear shipping, and would no doubt find favor in our Eastern markets.

Fruit ranging from an inch to an inch and a half in diameter has been marketed in San Francisco from Los Angeles County, but the specimens usually seen are of a much smaller variety. As the bloom appears in early winter, it may prove an uncertain bearer in the colder situations, and yet the tree be hardy and ornamental. A row of trees at James Shinn's place, near Niles, Alameda County, fruit freely. Mr. John Rock, of San Jose, has an early variety which ripens in June.



THE MEDLAR.

THE MEDLAR.

The Medlar (*Mesphilus Germanicus*) has been somewhat widely distributed in this State. The tree is deciduous; very beautiful, with large leaves and blossoms. A specimen in the

writer's garden, which was grown by Felix Gillet, of Nevada City, attained a height of about fifteen feet at ten years old. The fruit is borne regularly and freely, and, though considered of no account, has been eagerly carried away by those native to the Medlar country who have visited the place. The fruit needs the approach of decay to remove its harshness and astringency.

THE PERSIMMON.

The persimmon of the Southern States (*Diospyros Virginiana*) was introduced into California some time ago, as there are trees thirty to forty feet high growing on Rancho Chico. The widely-distributed species, however, is the Japanese (*Diospyros Kaki*), of which many varieties are now fruiting in different parts of the State. The tree is quite hardy and fruits freely both along the coast region and in the interior. It easily takes the form of a low standard, and with its large, glossy leaves during the summer, and its immense, high-colored fruit clinging to the twigs after the leaves have fallen, it is a striking object in the orchard or in the house garden.

Persimmons grow readily from seed but in most cases the improved varieties must be reproduced by grafting on seedlings either of the Japanese or American species. Thus far the trees have been so cheaply imported from Japan that little has been done in local propagation. The tree seems to thrive in any fair fruit soil, taking very kindly to close soils if well cultivated. The amounts of fruit now reaching our markets are increasing and a demand is found at fair prices, but there is no object now apparent for large increase of production.

There are many varieties of the Japanese persimmon grown, and, having been introduced under Japanese names, or having been rechristened with fancy names by the importers, much confusion has arisen in nomenclature. Professor Van Deman advises a return to standard Japanese names, and he has identified the following five varieties, which are the most largely grown in this State, by comparison of California and Florida fruit with Japanese plates and descriptions. The following is a condensation of Professor Van Deman's descriptions, which will enable many to name the varieties they are growing:—

YEMON.—One of the most common and valuable grown, because of its delicious flavor and productiveness; size from one and a half to three inches transverse diameter, by about half that much from stem to apex; very flat, with distinct and deep furrows running into the deep cavity at the stem, and shallow ones meeting at the opposite end, where a slight depression usually occurs; most specimens four-sided; color bright orange red; external appearance is much like that of a Trophy tomato; flesh unmixed orange red color, and so soft that when fully ripe it is best eaten with a spoon; seeds are almost if not entirely wanting; flavor is very sweet when soft, but astringent when hard; season early and does not require frost to ripen it.

HACHIYA (pronounced *Hah-chee-yah*).—One of the largest of all kinds; often three to four inches in diameter, and rare specimens have weighed twenty ounces; shape oblong-conic, but tapers rather abruptly at the apex; generally quadrangular; color dull orange with more or less dark specks, and very small and faint reddish streaks towards the apex; flesh quite firm, and of a brownish yellow color flecked with dull red. Owing to its solid character, this variety is largely used for drying in Japan. Ripens rather late, and sometimes has several seeds, which are always very long and slender.

TANA-NASHI (pronounced *Tah-na-nah-shee*).—A variety of superior excellence for eating from the hand, for drying, and making marmalade, etc.; size medium to large, about three inches in both diameters; conical, heart-shaped, very symmetrical, not furrowed or ribbed; stem cavity usually deep; skin very smooth and translucent, clear, reddish orange, covered with a delicate bloom; flesh tender, melting, about like jelly, clear orange yellow, not stringy or streaked; flavor not so sweet as some but very rich and pleasant; almost or entirely seedless.

ZENGI (pronounced *Zengy*).—One of the smallest varieties, from one and one-half to three inches in transverse diameter; form varies from distinctly oblong to globular. Sometimes slight depression at apex; dull red with yellowish cast, generally marked with black cracks about the point; flesh rather stringy, dark showing black dots and white fibers when cut transversely, and light-colored fibers with splashes of brown when cut vertically; quite seedy; flavor very good, se n astringent even when hard; very early and prolific.

TSURU.—Very long and slender; rather bright orange red; skin smooth with very little tendency to crack at point; flesh orange colored, rather dry; seeds few; very astringent when unripe; mainly valuable as a late keeper.

THE PINE-APPLE.

Casual experiments with the pine-apple in the open air in this State have been made for a number of years, the fruit being occasionally produced. In March, 1890, the growth of the pine-apple was begun in a more systematic way by Riley R. Morrison, of San Diego, and the early success of his plants in growth, and in some cases in production, excited considerable interest, and has awakened a disposition toward planting in the extreme southern county of the State, where an exceptionally equable temperature offers the most inviting conditions for this crop. It is now but little more than a year from the first planting by Mr. Morrison, and too soon, of course, to consider the success of the venture demonstrated.

The pine-apple thrives best on a fine sandy loam, but will grow well on many soils if well drained and cultivated. Mr. Morrison advises planting three by three or four by five feet, so as to allow cultivation both ways while the plants are young, instead of planting at smaller distances. Plants are secured from "suckers," which come from the root, from "slips," which grow on the stem just below the "apple," and from "crowns," or the tufts of leaves at the top of the fruit. Suckers are said to bear in one year, and slips and crowns in two years. Rooted plants may be set out in the spring, but otherwise planting in midsummer is pre-

ferred, as the ground is warm, and, if kept carefully moistened, rooting is surer than earlier in the season. The fate of the pine-apple in California promises to be determined in a year or two, and its outlook is now regarded by many as promising, provided locations are chosen where the conditions are suitable.

THE POMEGRANATE.

This fruit (*Punica granatum*), famed in literature and art, is grown in various parts of the State, and certain amounts are profitably sold. One of the most zealous advocates of the pomegranate is Ex-Governor Downey, of Los Angeles, who has written of it as follows:—

It can hardly be dignified with the name of tree, but in good soil will reach the height of twenty feet. We know it here as a beautiful ornamental shrub, bearing a beautiful fruit. In a hot summer's day there is nothing so charmingly delicious as a saucer of the pomegranate seed, sprinkled with pulverized sugar. It is cooling and refreshing, and a most agreeable febrifuge. In orchard or hedge it is pleasing to the eye of the cultivated taste. It is a hardy plant, easy of propagation, from the natural seed or from the slip or cutting. The latter is the easiest, as you are sure of the cutting as you would be of that of the willow, and with this advantage, that it does not require the moisture that the willow does. I have seen the charming plants in some of our deserted missions clinging to life, without care or cultivation, a generation after the good old fathers that had planted them had passed away. It can be planted with success from eight to ten feet apart, in orchard and in hedge, the same as the Osage orange, and will bear any amount of pruning. It will do well in any portion of the State.

Professor Ford gives the following appreciative description of the tree and its fruit, and notes on its requirements:—

The tree at maturity is from fifteen to twenty feet in height, having numerous slender branches often armed with thorns. The leaves are opposite, about three inches long and of a beautiful green. The flowers are produced at the end of the branches on the new shoots; the calyx is very thick and fruity and of a fine red color, the petals being crimped and scarlet. The beauty of the tree, not taking the fruit into account, has caused it to be planted in many of our gardens. The fruit is a large berry, covered with a hard, leathery coat and crowned with the tube of the calyx, contributing to its singular and beautiful appearance. A large number of seeds are contained in the crimson-colored pulp, which has a sprightly subacid flavor, agreeable and refreshing, although it requires some dexterity to separate it from its leathery covering without getting some of the juice or flavor of the latter in the mouth, which, owing to this skin being very rich in tannin, is quite astringent and bitter. It is ripened in Santa Barbara in October, but is not then gathered, but will remain on the tree for several months in good condition. To bring the fruit to its greatest perfection careful cultivation is required; in fact, a neglect of this will be paid in a penalty of barren trees. Fine specimens are always shown at our autumn exhibitions, and it is occasionally found in our markets.

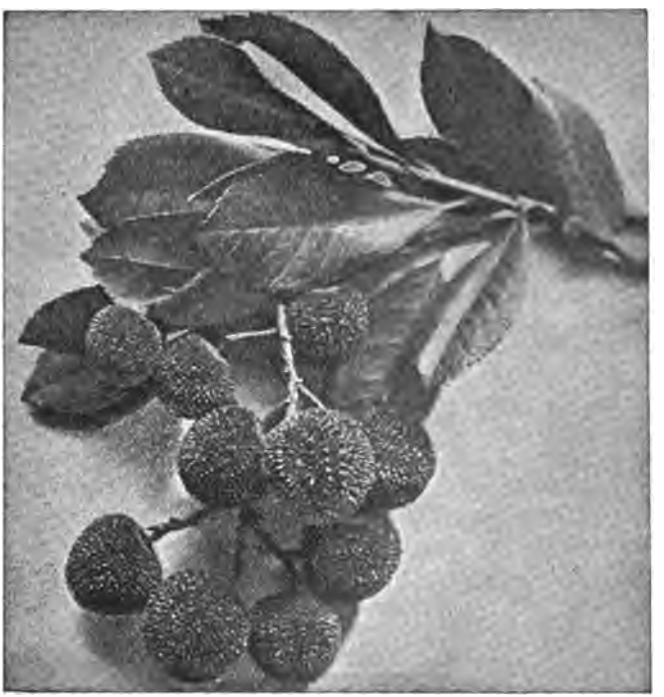
Concerning the fruiting and varieties grown Mr. Klee says:

Exposed to the raw sea winds it does not set with fruit, and is best adapted to the warmer regions of the interior, where it is an early and abundant bearer. The variety chiefly cultivated is a bright orange color, but there is found a large variety of them, varying from almost pure white with a faint blush to dark red; is growing on the grounds of Mrs. Americh, near Los Gatos, Santa Clara Valley; they all seemed to reach perfection on the gravelly soil, receiving some irrigation.

Ex-Governor Stoneman is a large grower of pomegranates on his place in Los Angeles County. In the Sackett orchard, on the south bank of Putah Creek, in Solano County, pomegranates are grown as low standard trees for convenience in cultivation, etc. The fruit is shipped from this locality in October.

THE STRAWBERRY TREE.

The Spanish madroño (*Arbutus unedo*) is now quite widely grown, chiefly as an ornamental shrub or tree. Plants have been distributed from the propagating grounds of the State



THE STRAWBERRY TREE—FRUIT AND FOLIAGE.

University at Berkeley, where the tree has been in bearing for the last ten years. Two large trees in the garden of J. L. Mosher, at San Jose, are perhaps the oldest in the State. The growth is exceedingly beautiful if kept free from scale insects, the fruit ranging as it ripens through shades of yellow, orange, and deep red, and contrasting beautifully with the glossy evergreen foliage. The fruit is of pleasant flavor. The engraving was prepared by Mr. Lelong, from fruit grown by Mr. Mosher.

MELON SHRUB.

This plant (*Solanum Guatamalense?*) is described by Mr. Klee as a small, half-herbaceous shrub, which was brought to California from the table-land of Guatemala by the late Mr. Grelck, of Los Angeles. The fruit is yellow, splashed with violet, somewhat of the shape of the egg plant, but is usually seedless, and is readily propagated from cuttings. Plants grown at Berkeley have not succeeded well. There were thriving plants at Mr. Grelck's place in Los Angeles several years ago, but from all indications the fruit ripens rather late, and requires a more tropical summer to reach perfection. Few persons seem to like their flavor, which is something like a tomato and melon mixed. Fruits were first sold in Santa Barbara market in 1887.

THE MELON TREE.

The melon pawpaw (*Carica papaya*) has been widely introduced experimentally in this State, and most situations are found unfitted for its growth. There is a tree at an elevation about four miles east of San Diego Bay which has reached a height of twelve feet or more, and has fruited freely, the fruit being five or six inches in diameter.

THE PRICKLY PEAR.

The *tuña*, or fruit of the cactus (*Opuntia vulgaris*), is produced in nearly all parts of the State except on the mountains. It was one of the old mission fruits, and was enjoyed by the early mining population until better fruits were available. It is about as large as a medium-sized pear, and has a pleasant acid flavor if one succeeds in escaping the prickles in getting at the interior of the fruit. The *tuña* is still a commercial article in a small way. Plants are grown readily from cuttings of the fleshy leaves.

THE ALLIGATOR PEAR.

The avocado, or *Agua cate* of the Mexicans (*Persea gratissima*), has proved hardy in several districts in the State, north and south. The tree has borne fruit in the garden of Mrs. F. Sawyer, of Santa Barbara, and Professor Ford gives a sketch of it, as follows:—

It was planted by Mr. Silas Bond sixteen years ago, and has borne fruit for the past three years. This tree is almost twenty feet in height, and appears in a thriving condition; the bark is smooth; leaves oblong, with prominent veins; flowers yellowish green; fruit purple in color with the dimensions of a medium-sized pear, but more oval in shape. It contains a kernel, inclosed in a soft rind, and yellowish pulp. The latter has the delicate, rich flavor of the peach, yet to most tastes much more gratifying.

THE WHITE SAPOTA.

One of the early Mission fruits which has hardly increased from the original planting, is thus described by Professor Ford:—

In the grounds, and occupied by one of the Mission gardens, is a tree about two feet in diameter, with sturdy, upright branches forming a beautiful head of dark green leaves. This is the white sapota (*Casimiroa Edulis*), and planted about ninety years ago by one of the Mission Fathers; as near as can be ascertained, there is another tree of the same species growing in a garden in the lower part of the city of Santa Barbara, that came from seed received from Mexico and planted about forty-five years ago. It is growing both wild and cultivated in the States of Sinola and Durango, and elsewhere in Mexico, and is known as the *Lapote blanco*. It belongs to the *Rutaceæ*, and is more nearly allied to the orange than any other American plant. Its leaves are palmeate, three to four parts, with glistening upper surface; flowers small, greenish yellow, growing in clusters, with short peduncles on the old wood. Here the tree is usually in flower during January, often earlier, the fruit maturing in March or April. It varies from half an inch to an inch in diameter, pale yellow in color, and is not agreeable to the taste until in a soft state. It has a rich, subacid flavor, our native Californians being exceedingly fond of the fruit. The older tree is about twenty-five feet high, and has about the same spread of branches, while the younger is nearly as large, both forming fine heads of dense evergreen foliage, making it desirable as an ornamental tree for street or other planting, and would no doubt bear the climatic conditions of many other localities.

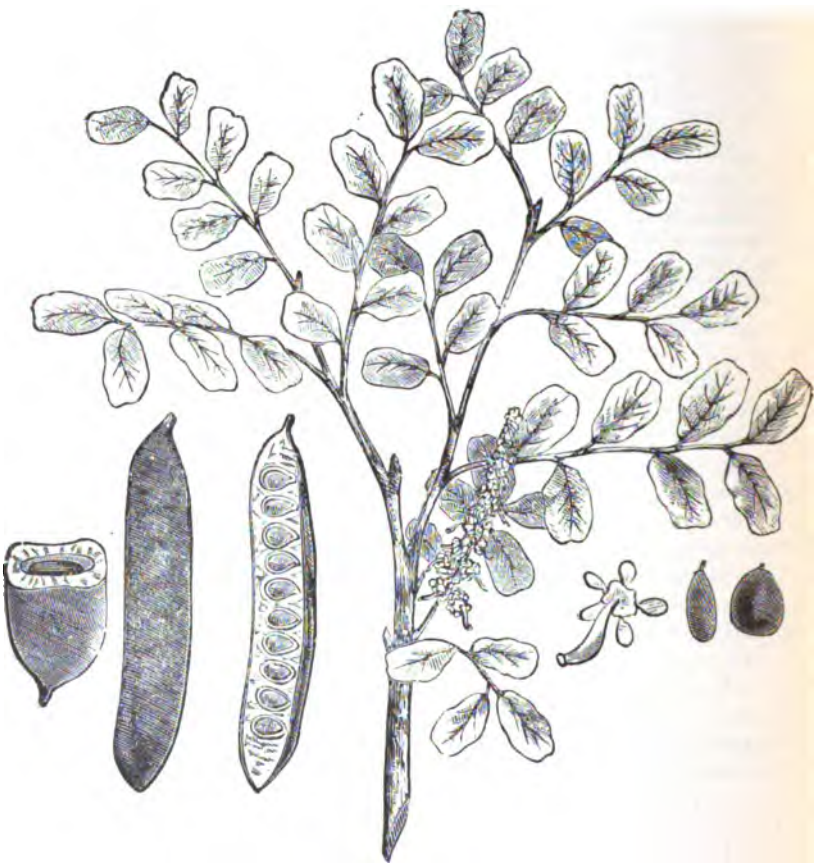
NATAL PLUM.

The *Carrisa grandiflora* is a native of South Africa, and bears a fruit which is described as about the size and form of an egg plum, with bluish-purple skin and dark yellow flesh of delicious plum flavor and tartness, but the fruit has no pit but a number of small seeds. Such a description given by a soldier of the late Zulu war to O. S. Chapin, nurseryman of Poway, San Diego County, induced him to secure seed through the United States Consul from a South African nurseryman, who also commended the fruit. Mr. Chapin has propagated the plants and expects early fruiting. The plant is a thorny evergreen shrub or small tree of glossy foliage and bears a blossom of tuberose texture and fragrance. The thorns are peculiar in being doubly forked and terminating in four points. It will make a handsome hedge plant. The fruit is much esteemed in its native country for canning and for jams.

THE KAI APPLE.

The name is applied to the fruit of *Aberia Caffra*, a native of Natal and Caffaria, a tall shrub, yielding an edible fruit of a golden yellow color, about the size of a small apple. It is commended as a hedge plant, as it is densely clothed with strong dry spines. The leaves are small and of a rich green hue. The fruit is chiefly used for making preserves. The seed was obtained by the experiment station of the University of California

in 1887, as a donation from Mr. Thomas Hanbury, an amateur, whose gardens at La Martola, Italy, are especially rich in rare growths. The plant grows readily from seed, but can also be multiplied rapidly by cuttings, using bottom heat. In this way plants can be secured for hedge-planting without waiting for the stock plant to reach bearing age. The plant has been widely distributed from the University of California, but has not yet borne fruit in this State.



THE CAROB, ALGAROBA, OR ST. JOHN'S BREAD.

THE CAROB.

Enough has been done in this State with the carob (*Ceratonia Siliqua*) to demonstrate the fitness of local conditions for this fruitful tree, which is of such wide utility in the Mediterranean

region. The trees now growing at several points in the State are from seed; the effort to introduce grafts from the best foreign varieties has not yet succeeded. Bearing carob trees can be seen on the farm of Mrs. J. Arnerich, near Los Gatos, and of James Shinn, near Niles. In these cases the trees bore at ten and twelve years from the seed, at which time they had a height of about twelve feet. Thrifty growth is made in very dry situations without irrigation, and indicates the adaptation of the plant for arid lands which will not support ordinary orchard growths. The carob is grown from seed or by grafting into seedlings. Pour water nearly at the boiling point over the seed and allow to cool gradually, soaking the seed for twenty-four hours. Plants can be grown in boxes or in open-ground seed beds much as already described for orange seedlings. The carob is dicœcious, consequently, to be sure of the desired sex, the seedling should be grafted from blooming trees in the proportion desired. The tree is a very handsome evergreen.

OTHER FRUITS.

The foregoing enumeration does not include all the exotic fruits which have found a place on Californian soil. There are many more, some of which will probably demonstrate their fitness to add to the graces or the gains of our horticultural life.

PART SIXTH: SMALL FRUITS.

CHAPTER XXXIV.

BERRIES AND CURRANTS.

IN suitable soils and situations, and with proper care and cultivation, the small fruits sustain the general reputation of California by the size and quality of the product, and by the long-continued and abundant fruiting of the plants. Probably nowhere else in the world do small fruits better repay generous treatment than in this State, and probably nowhere do they suffer more from neglect. There are parts of the State, of course, where some small fruits, left to their own resources, thrive and bear abundantly, but, speaking of the State as a whole, the price of success is intelligent devotion on the part of the grower.

There are localities in California which favor almost continuous growth and fruiting of some of the small fruits, and it is no fiction to say that in such a place one may have raspberries and strawberries upon his table every month of the year. Such situations are the thermal belts, which are practically frostless, and, by securing favoring moisture conditions in the soil and proper varieties of the fruits, the existing temperature conditions will produce the results indicated. Though this be the case, the profitable growth of small fruits is not, of course, restricted to such situations, but the largest commercial enterprises are carried on in places where the summer-crop rule prevails, but the bearing season is much longer than in the Eastern States.

Small fruits for family use may be grown on all fertile soils, and therefore they should be produced on every farm. Growing for market on a large scale involves considerations of ease of cultivation, water supply, and facilities for transportation, which will probably occur to anyone who gives the matter the thought and personal observation of existing small fruit farms, which such an important commercial venture should command.

Preparation of soil for small fruits should be most thorough and careful. Even more generous work than that commended in Chapter X for trees and vines should be done. It is the more necessary to work deeply because subsequent culture of small fruits must be shallow.

THE BLACKBERRY.

The blackberry is a great favorite in California markets. It thrives in all parts of the State, and the plant is best suited of all small fruits to yield generously without irrigation, though it relishes sufficient moisture and repays it with fruit. There is great difference in practice as to supplying water artificially. The growth of cane, and the size and appearance of the fruit, will show the observing grower what should be the practice in his situation, and the general suggestions as to irrigation on pages 207 and 208 are applicable. There are regions in which blackberries are irrigated weekly throughout the summer, and others in which the berries are gathered from June to November without irrigation. Of course, with such wide local variations, there can be no general rule for practice. Let the grower simply bear in mind that if he does not get good, plump, and glistening fruit and good strong growth of new canes at the same time, he should give irrigation. The requirements of the plant during the fruiting season are great, and they must be met.

PROPAGATION.—Blackberry plants are secured by digging up the shoots from old stools, securing therewith a bunch of fibrous roots with a portion of the main root. To propagate on a large scale dig up the roots entirely, and, cutting them up with pruning shears into pieces about two inches long, plant them in a well-prepared bed in the garden or nursery. Place the root cuttings about two inches apart and cover about three inches deep with well-pulverized soil, the depth being regulated, of course, according to the nature of the soil, deeper in light than heavy soils. A light mulch will assist in retaining moisture. The time for this work is at the dormant period of the plant. One summer's growth gives good plants for setting out.

PLANTING OUT BLACKBERRIES.—Blackberries should be planted in rows far enough apart to admit of the use of the horse and cultivator. As the constant tendency of the plant is to extend itself in the growth of new canes, the rows should not be less than six to eight feet apart, and the plants about three feet apart in the row. The plants soon occupy the full space in the row, and cultivation is only possible between the rows. Some growers plant blackberries as they do grape-vines, seven or eight feet apart both ways, and then cultivate with the horse both ways. Planting in rows is better. The number of plants to fill an acre at different distances can be calculated as described on page 381.

D. Edson Smith, of Orange County, who has much experience with small fruits, describes his method of laying out and planting on a large scale, with a view to irrigation, as follows:—

Plow deeply and harrow thoroughly several times before setting out. Lastly, open a trench with your plow where the row is to be, twenty inches deep; go along with a basket of plants, a four-foot lath and a shovel, and set a plant in this trench every four feet and fill the dirt around it with the shovel. If the trench is too deep in places for the length of the plant root, fill in a little dirt; if not quite deep enough in places, scoop out a shovelful. Aim, in preparing the ground with plow and smoother, to leave it dishing each way toward the row of young plants, so that irrigating water turned in at the upper end will run along the row of plants as in a trough. Aim to have the ground around the set plants a few inches below the general level of the land. After the plants are all set in a row, go along with a rake, if there are but a few plants, or with a horse-hoe if there are many, and fill in the trench between the plants. It is a pleasure to set out plants in this way, and such deep, rich, well-stirred soil delights the plant roots, so that they grow rapidly in every direction, and the plants throw up their heads in a manner entirely satisfactory to all concerned. If the ground is dry, or there is no rain soon after setting out the plants, irrigating water should be turned down the row, or at least a quart or two of water poured around each plant; then, before the soil hardens, stir it well with cultivator and hoe. All future care resolves itself into frequent waterings and frequent stirrings of the soil. Allow no weeds to appear, and keep three inches of surface soil well loosened with the horse and hoes. These small fruits require frequent waterings, especially when forming fruit and during the fruiting season.

CULTIVATION.—Thorough cultivation of the surface soil is essential for retention of moisture. After the plants attain size, cultivation should be secured with as shallow-cutting tools as possible so as to prevent injury to the roots, which not only weakens the plant, but increases the growth of suckers between the rows. A horse-hoe with a long knife running horizontally, or with duck-foot teeth, well sharpened, answers well in keeping the ground clear of weeds and suckers, and the surface loose.

Frequency of cultivation depends upon irrigation for the cultivator must always follow the application of water. The benefits of surface cultivation, as described in Chapter XIII, are of especial force in this connection.

The spaces in the row which cannot be reached with the cultivator must be kept clean from weeds, and free from baking, by the use of the hoe. It is advisable that the cultivation be the cleanest possible, for moisture exhaustion by weeds cannot be afforded.

PRUNING AND TRAINING.—There is a little difference in the way of training blackberries practiced in this State. Of course this does not include the "let alone" system, which is not followed by any good grower. The difference lies mainly in the use or disuse of artificial supports for the canes—the prevailing practice being to dispense with them. In either case the pruning of the canes is similar in kind but different in degree, for if no supports are used, the canes are headed lower.

At planting out, cut back the cane to near the surface of the ground and mark the plant with a small stake. At first the top growth should not be checked, but when new canes grow out strongly they should be pinched at the tip to force out lateral branches for fruiting the next year. Those who intend to tie canes to a stake or trellis let them attain a height of five or six feet before pinching off the terminal bud; those who intend to teach the cane to stand alone pinch when it is from two to four feet high. All agree to pinch off the ends of the lateral branches at about twelve inches from the main stem. This pinching of blackberry canes may be done by the watchful grower of a few plants, with the thumb and finger, but thrifty blackberry plants are such rapid cane growers that in large plantations cutting back is often done with a sickle or corn hook or sharp butcher knife, several times in the course of the summer. It is also advisable to thin out the suckers with the hoe while cutting out weeds, leaving only about as many as it is desired to have for fruit the next season. After the leaves fall, the canes which have borne fruit during the summer are all cut off even with the surface of the ground with long-handled pruning shears or with a short, hooked knife with a long handle, and all *débris* removed from the rows. This method gives stout canes, with plenty of short side branches, well supplied with buds, which will send out fruiting shoots the following spring.

If supports are used, the four to six canes which are left to each stool are gathered with in a loosely-drawn bale rope and tied to the stake; or if a trellis is used, the branches are brought up to the wire or slat so that the distance is about evenly divided between the shoots.

Though these systematic methods of summer pruning are practiced and advocated by the most careful growers, it should be stated that there are large plantations which are conducted upon a more simple system. The pruning consists in cutting out old canes in the winter, and the only summer pruning is slashing off those canes which interfere with cultivation. The canes are sometimes held up by tying bunches of them together with ropes. Of course this system costs less than the more careful one which has been described, and yields profit enough to induce adherence to it. No doubt quite as great weight of berries could be had from a smaller area by a better system of growing.

APPLICATION OF MANURE.—The blackberry loves very rich ground, and plenty of well-rotted stable manure or compost, as described on page 200, should be applied. It is a good plan to apply in a thick covering all over the ground and between

the canes as soon as the patch is cleaned up in the fall. The early rains carry down the soluble parts of the manure, and later in the season the whole is plowed in between the rows, leaving a foot or more next the plants to be carefully forked in, as the digging fork does not cut the roots like the spade.

MULCHING.—The mulch, to keep the ground moist and to obviate summer cultivation, is very satisfactory where it is thoroughly done. Apply coarse manure or partially-rotted straw and the like, after the last spring cnltivation, and use the hoe to keep down weeds and suckers which come up between the rows. Some growers use mulch close to the canes, cultivating the remainder of the ground between the rows.

BEARING AGE AND LONGEVITY.—If blackberry plants are well treated the first year after planting out, there will be considerable fruit the following summer. How long the plants will bear satisfactorily depends, also, on situation and treatment. Sometimes the plants fail early; even with good, generous treatment in good soil, the old stool becomes weak, the shoots are thin, and the fruit small. Some count about eight years as the profitable age of the plant, and then cut out the plants and give the land a change. Of course berry growers prepare for this by frequently making new plantations.

VARIETIES OF THE BLACKBERRY.—Comparatively few kinds are largely grown. The early Wilson, Lawton, and Kittatinny are the prevailing kinds, ripening in the order named. The Early Harvest is favorably reported by a number of growers. The Old Dorchester is still grown to some extent. The Boston High Bush is still found here and there. The newer kinds brought out in the Eastern States are being tested in this State. A renamed variety, Crandall's Early, is gaining favor in a number of counties. It is the earliest of the improved varieties, and has a very long fruiting season. The fruit was first distributed by W. R. Strong & Co., and by them named after Dr. J. R. Crandall, of Auburn, who first fruited the variety from plants given him by a stranger hailing from Texas. D. Edson Smith, of Orange County, says:—

> Of the varieties of blackberries, I am now setting out only the Crandall. Perhaps the flavor of this berry is not so fine as some other varieties, but in all other respects I think it much superior. It is a strong, vigorous, hardy plant, very productive, of firm, handsome berries, fruits over a larger season than any other variety I know of, and the vines will not run all over your place. In fact, you will not get enough suckers or sprouts to set out a new row.

Some growers claim that the Crandall requires higher training and more room than other varieties. Mr. Smith lays off his rows twelve feet apart, heading off the canes at about three feet and the laterals at eighteen inches.

An evergreen blackberry has been introduced in this State from Oregon. Mr. John Rock describes it as follows: "Origin unknown; beautiful; cut-leaved foliage, which it retains during the winter; berries large, black, sweet, rich, and delicious. It continues to ripen from July to November, which makes it one of the best berries for family use."

Some effort has been made to secure improved varieties of our native blackberry. The Aughinbaugh variety is mentioned on page 55. Although, as there stated, it is of little account as a commercial variety, it is grown by a few with good results when interplanted with other varieties. It is also being used as a parent of other sorts by crossing. Judge J. H. Logan, of Santa Cruz, is experimenting with seedlings of the Aughinbaugh crossed with Crandall's Early, and has secured some plants bearing large, well-formed berries of excellent flavor.

THE DEWBERRY.—The improved varieties of the dewberry, or trailing blackberry, have been introduced in this State, and good fruit has been grown in an experimental way, but the culture has attained no commercial position. The fact that the vine has to be trellised, and is otherwise rather more difficult to handle than the blackberry, will hold growers to the blackberry until the purchaser here will pay more for the dewberry, as is done at the East. Still for a luscious fruit in the home garden the dewberry is worth trial. The Mammoth and Lucretia varieties are now grown in this State.

AN IMPROVED CRANBERRY.

THE CRANBERRY.

Though some little attention has been given to experiments with the growth of the cranberry in California, it has not been demonstrated that the culture is successful or profitable. Cranberries have been produced, and the fruit shown at fairs, but beyond this nothing has yet been accomplished. Mr. H. Nyland, an experienced cranberry grower from New Jersey, began experiments on Bouldin Island, in the Sacramento River, in 1875. He argued theoretically that the tule islands were suited to the cranberry, that the expensive operation of sanding

was not necessary in this State, where there is no frost to "heave" the plants out of the ground, etc. Mr. Nyland exhibited a plant covered with fruit at the Mechanics' Fair in San Francisco, a few years ago, but since that his enterprise has not claimed public attention. Until someone shall prove otherwise, the inference will be that California conditions do not suit the cranberry. A few wild cranberries are shipped to California from Oregon each year, but the chief supply is the cultivated fruit from Eastern regions.

THE CURRANT.

The currant reaches perfection in size and quality in parts of California adapted to its growth, but its area is comparatively small. The plant does not thrive in the dry, heated air of the interior either at the North or South. It does well near the coast, especially in the upper half of the State, and is grown for market chiefly, on lands adjacent to and on the east side of the bay of San Francisco. The comparatively cool and moist air of the ocean favors it, but even here the sunburn, which is the bane of its existence in the interior valleys, occasionally injures the fruit. Away from the coast currants are grown to a limited extent along the Sacramento and San Joaquin Rivers, near their confluence, but not in the hot valleys whence they flow. On the foot-hills, too, where the plant has a northerly slope, or other cooling influence, and sufficiently moist soil, it will do moderately well. It is quite possible that the currant may be satisfactorily grown for home use, or for local market, in parts of the State where at present one does not find it, providing the moderating effect of elevation and northerly exposure, coupled with the shade of trees, be secured, but even then the hot north wind of the early summer may often injure the fruit. So far as the metropolitan market is concerned, it does not matter that the currant area is limited, for existing plantations produce all, and sometimes more, than can be profitably disposed of at present.

PROPAGATION.—The currant is readily grown from cuttings. As soon as the bush drops its leaves, and the ground is in condition, as to moisture, secure the cuttings a foot in length from straight wood of the last growth, and place them in nursery or in permanent place, in good sandy or garden loam, spaded and broken up to a depth of eighteen inches. Set the cutting firmly in the earth, six or seven inches deep. If they are to be trained as small trees, every bud below where the lowest limb is to start should be cut out—even to the end of the cutting under-ground

—otherwise they will be continually throwing up suckers. If they are to grow as bushes, the natural and more productive form of the currant, set them as they are taken from the parent bush.

PLANTING AND CARE.—Currants are usually grown in rows about five or six feet apart, the plants standing two and a half or three feet apart in the rows. Most of the currant plantations are between orchard rows, the partial shade of the trees being considered desirable. It is claimed that currants do best when interplanted with cherry, apricot, apple, and pear, not so well when associated with plum and peach, and the almond is least desirable. The cultivation is such as is usually given to the orchard, except that in heavy soil the plow is not allowed to come near the cuttings the first season for fear of tearing them from their rooting. After the first year the plow is used in the winter and the cultivator in summer.

Currants well repay generous applications of well-rotted manure, and relish sufficient moisture in the soil. Where this cannot be had from rainfall, and retained by cultivation and mulching, irrigation must be resorted to.

PRUNING.—If the currant is to be grown in tree form, the branches from the upper buds of the cutting should be shortened in at the end of the first summer, and branches growing horizontally should be removed. The weaker shoots in the head are thinned out, but not so much as to leave the top too open. If the plant is to grow as a bush, the only winter pruning will consist in removing dead wood, and thinning the new shoots as may seem desirable. Summer pinching of the new growth is desirable, as it causes the fruit to set closely and tends to a thick growth of foliage also, and this is necessary, for the bark is liable to sunburn, and the best fruit is that which is well sheltered by the leaves. Another advantage of the bush form is the less likelihood of killing by borers, which is imminent when the growth depends upon a single stem. There seems to be, however, a different behavior of varieties under different training; the cherry currant is thought to do best when systematically pruned, and the Fertile de Paluau likes its own way in growth and suckering.

BEARING.—The currant bears a quantity of excellent fruit the second year from the cutting, and reaches its fullest product about the fifth to the eighth year, when the yield in the Haywards region is said to range from one and a half to three tons to the acre.

VARIETIES.—The cherry currant is the prevailing variety, although the old sorts the Red and White Dutch, the Fertile

Currant of Paluau, the Red and White Grape, etc., are grown in some localities, and Fay's Prolific is approved by some growers.

Black currants are but little grown, the market demand for them being very light.

THE GOOSEBERRY.

The gooseberry is another fruit with somewhat circumscribed area in this State. In localities which favor it, the fruit is often found very profitable, but the demand does not warrant any great increase of product. Though the gooseberry thrives in some situations which do not suit the currant, they may both be described as averse to the hot and dry parts of the State. Still, for home use or local sale one can grow certain varieties of gooseberries successfully, by protecting them from too great exposure to the sun, and by keeping the soil sufficiently rich and moist. The choice of varieties is of the greatest importance, as will be mentioned presently. At present the chief supplies of the gooseberry, as of the currant, are produced in the country adjacent to San Francisco Bay, though thriving and profitable plantations are found elsewhere near the coast, here and there in the interior, and at considerable elevations on the slope of the Sierra Nevada.

PROPAGATION, PRUNING, ETC.—The gooseberry is grown from cuttings, very much as already described for the currant. The common and the best method is to start the cuttings early in the winter, though some have succeeded with cuttings taken in the spring just as the new growth is starting out. Disbudding the lower part of the cutting if it is desired to train in tree form is also practiced with the gooseberry, but a smaller percentage of cuttings is found to grow after disbudding. Concerning growing plants from cuttings, W. B. West, of Stockton, who has given the subject much attention, says:—

> The English varieties do not propagate as easily as the American. Cuttings of the former should be taken from near the ground, and if they can be found growing from under it, all the better. They should be taken from the old plant very early in the winter; and, if the ground is not ready for the planting, they should be heeled in and kept moist. Layers are more certain to make a plant. If well rooted, they can be planted out where they are to remain after one season. The American kinds propagate easily from cuttings.

Gooseberries are planted out and cultivated as already described for currants, and the requirements of the plant in soil, moisture, and manuring are much the same.

If the gooseberry is to be grown in tree form, constant attention to removal of suckers is necessary; if in bush form,

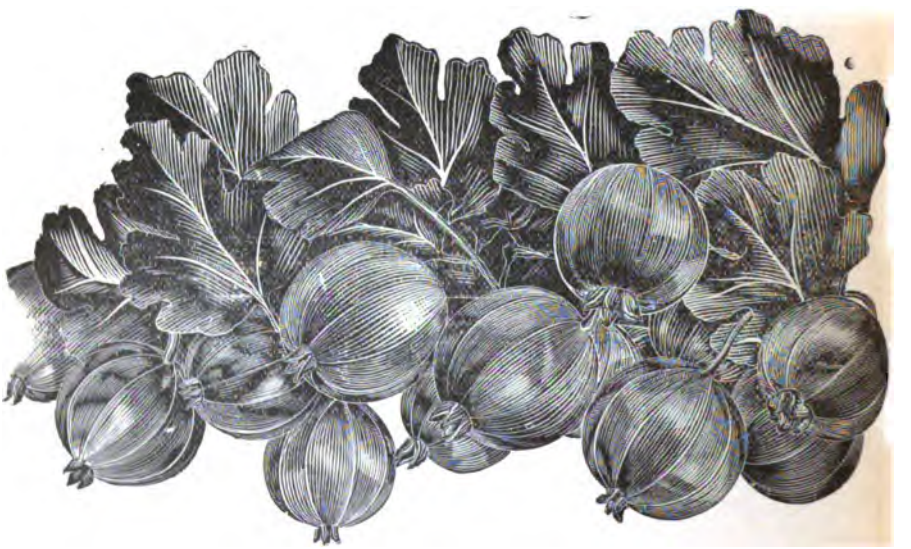
it will only be necessary to remove too old wood and to thin out the new shoots. Suckers should be removed clean from the stem, so as to eradicate the latent buds, and pulling off with a gloved hand, when the suckers become woody enough to withstand breaking, is advised. As with the currant, the borer is a constant menace to the life of a gooseberry plant confined to a single stem.

THE BERKELEY GOOSEBERRY—A RENAMED VARIETY.

DISEASES AND PESTS.—The gooseberry is subject to insect depredation both in wood and fruit and leaf. The prevailing trouble, however, and that which causes the failure of so many foreign kinds, is the mildew. To escape this nothing is done except to select varieties not subject to the disease.

VARIETIES OF THE GOOSEBERRY.—The American varieties, Downing and Houghton's Seedling, chiefly the latter, constituted for a long time the main varieties marketed in San Francisco. Early experiments with collections of English varieties showed that most of them were failures because of mildew, still a few of the green and white sorts, notably the Whitesmith, have succeeded. The proportion of large berries now being marketed is much greater than formerly, and the superior price warrants especial effort to produce them. Mr. West condenses his experience of thirty years in these words:—

My first stock was obtained from Hovey & Co., Boston, in 1856; it was as fine and complete a collection as could be procured in America, comprising the largest and best of all the different kinds, red, yellow, green, and white. It took only a short time to determine that the red ones, which are the largest and best in Europe, were useless here. The Crown Bob, Roaring Lion, and others equally famous, were of no value to me. I soon discarded all but a few green kinds, and one white variety, the "Whitesmith." These have been propagated and sold largely and always gave satisfaction. Thinking that I might learn something more about this fruit, I selected in England, during my last visit (1878), about twenty of their best kinds, some of them red, as in my previous collection. They have shown the same characteristics as my previous lot; that is, only a few varieties of the white and green are worth growing. They are free from mildew, but the berries are not as large as some of the red kinds.



THE CHAMPION GOOSEBERRY—AN OREGON SEEDLING.

A large English variety which was brought to California many years ago, by the late John W. Dwinelle, is now the most widely distributed large kind. Its true name was lost, and it

has been propagated under various names, viz., Dwinelle, Kelsey, New French; but the name Berkeley, adopted by W. P. Hammon, in his wide distribution of it in 1884, now prevails. It is large and handsome, very prolific, ripens early, and is usually free from mildew. The engraving of this variety which is used herewith is from the catalogue of Trumbull & Beebee, of San Francisco.

THE BLACK MULBERRY AS GROWN IN CALIFORNIA.

Recently varieties originating in Oregon have secured distribution in California. The Champion, a seedling grown by Seth Lewelling, is a leader of the new varieties, and was first grown in California by J. D. Smith, of Livermore. The engraving, from the catalogue of the California Nursery Co., gives the general appearance of the fruit, which is medium sized, very smooth, and thick fleshed, the seeds being few and small. They are entirely free from mildew, and are clean, bright, and beautiful.

Another variety is the Puyallup Mammoth, originated by J. M. Ogle, of Puyallup, Washington, and named by the local Fruit Growers' Association. It is described as large and free from mildew, and the bush very prolific.

THE MULBERRY.

Nearly all varieties of the mulberry have been introduced in California and grown rapidly and thriftily. Most attention has been paid to those varieties most suitable for feeding silk-

worms, but the fruiting varieties are also grown here, though the fruit has assumed no commercial importance. The mulberry is grown readily from cuttings. The fruiting varieties thus far chiefly distributed are the Downing Everbearing, the Persian, the New American, the Russian, and the Black Mulberry of Spain. All these bear large and desirable fruit. The last named, as fruited by Felix Gillet, of Nevada City, is shown in the engraving, The mulberry has a long season; the Persian ripens in Tulare the last of May and continuously thereafter until October.

THE RASPBERRY.

The raspberry is another of the great small fruits of California. It thrives over a great area of the State; in fact, there are few situations in which it cannot be grown, if proper attention is given to retention of moisture in the surface soil, and to giving the plants partial shade in the heated valleys, and the cooler exposures in the foot-hills. The raspberry, skillfully pruned and generously fed and cared for, is almost a constant bearer, as has already been intimated. It is a continual delight in the home garden, and always brings a high average rate in local and metropolitan markets.

The culture of the raspberry is in the main like that of the blackberry, as already described. The red varieties, which are the kinds almost exclusively grown in this State, are propagated by suckers and root cuttings like the blackberry, but the "black caps" are propagated by layering the cane tips during the growing season. Bending down a cane with its branches and covering lightly with soil and with a light mulch to retain moisture, will result in free rooting of the buried parts, and one can sometimes secure a dozen plants by the layering of a single cane with its laterals.

The pruning of the raspberry is also by the renewal system, as advised for the blackberry. The topping off of new canes, when they reach about three feet in height, the subsequent pinching of laterals which are thus forced out, the resolute thinning out of sprouts so that but three or four strong canes are allowed from one root, the faithful repression of all weeds, the maintenance of a loose surface layer of the soil by very shallow cultivation, the free application of manure and of water unless a continually moist condition near the surface can be secured by cultivation and mulching,—all these are among the essentials of cultivation which will secure abundant fruit and a long bearing season. However, as has already been stated with regard to blackberries, there are large plantations which pursue a less careful system of cultivation.

Continuous bearing of the raspberry may be secured in those varieties which endure the treatment, by cutting out a cane as soon as its fruit is gathered, the force of the plant being then devoted to the fruiting of a second cane, which has previously been pinched, and a third shoot is pinched and allowed to mature its wood to carry over and bear the first crop of the following year. A succession of sprouts is gained by pinching off the tips of some as soon as they have grown up a few inches, which results in the growth of later shoots lower on the stems. In this way a succession of fruit is obtained.

The Cuthbert and other strong-growing varieties, after the pinching at about three feet from the ground, will send out laterals which will bear late in the fall, and the same cane will bear a crop early in the following spring, when its career is ended and it should be removed.

Raspberries are planted about three feet apart in the rows, and the rows about six feet apart. They can be well grown nearer together than is required for blackberries.

VARIETIES OF THE RASPBERRY.—The old standard varieties have been largely replaced by the newer kinds. The Red Antwerp is retained as an early berry; the Hansel is gaining some favor; the Herstine is a leading variety in some of the large producing regions supplying the San Francisco market, but is reported a shy bearer in some parts of the State. The Cuthbert is the universally popular and most largely-planted sort, and the one almost exclusively grown in Southern California, having been found trustworthy as a grower and as a free and constant bearer. The good points of the Cuthbert, as representing the experience of many California growers, include the following: A profuse grower with healthy and rich foliage, which protects fruit from sunburn; an excellent bearer with the fruit well distributed through the bush; the fruit comes off easily, and does not crumble, is of fine flavor, and ships well.

D. Edson Smith commends the New Rochelle for Southern California, as well as the Cuthbert. Of its qualities he says:—

> The most profitable raspberry that I have tried is the "New Rochelle." It seems to be a cross between the Cuthbert and Doolittle. It passes for a red berry, but it propagates from the tip like the Black Cap, and partakes largely of the Black Cap flavor. This berry is exceedingly hardy and vigorous in its growth of cane, and is a very prolific bearer. The fruit is much firmer than most of the red varieties and will bear shipment well. Its quality is somewhat inferior, but its earliness more than compensates for this. It is the first berry in the market, and for that reason tastes exceedingly fine.

The Black Cap varieties thrive fairly in most parts of the State, but do not sell well in the markets, and are only grown

for home use. The golden or yellow raspberries are also out of favor because they are shy bearers and cut no figure in the California product.

A foundling variety which is now largely grown in the foothill region has been named the Barter, and is described by W. R. Strong & Co., of Sacramento, as follows:—

First cultivated by Mr. William Barter, of Penryn, Placer County. Some years ago a friend gave him two raspberry plants; one of them died, and he, having discovered the living plant to be a berry of superior variety, propagated it as rapidly as possible, and has for several years produced the largest crops of the finest berries. It is thought to be a new variety, and the best berry for general cultivation in his berry-growing district (out of more than fifty varieties that have been tested). It is a very large, red berry, often measuring nearly or quite an inch in diameter, round, a little flattened, frees easily from the stem, fine flavor, quite firm, and carries well. It grows very large, strong canes, bears heavy and uniform crops.

Some attention has been paid to improved varieties of our native raspberries. Mr. Burbank, of Santa Rosa, has grown seedlings from an exceptionally fine plant found in Medocino County, bearing large, sweet berries, and has on trial a number of interesting hybrids.

THE STRAWBERRY.

"Strawberries all the year round" is the trite expression by which the charms of the California climate are characterized. It is no fiction, for in the wonderfully-even climate of regions adjacent to the coast and in thermal belts in the interior, the strawberry plant blooms and bears almost continuously, providing proper moisture conditions are maintained in the soil. There are, however, more or less well-defined crops, and "strawberries all the year" does not mean a uniform supply; nor does it mean that everywhere in California can one expect such constant fruiting. In the very hot interior situations the plant rebels against the atmospheric conditions of midsummer, even though the ground be moist; and in low, frosty places, or at elevations on the mountains, the plant becomes dormant during the wintry portion of the year. The conditions of constant growth and bearing are moderation of temperature and of atmospheric and soil moisture throughout the year. Of these conditions nature supplies the first two, and the cultivator the third, for generous irrigation is the price of a long bearing season with the strawberry.

SITUATIONS AND SOILS FOR THE STRAWBERRY.

Bearing in mind the conditions described, the strawberry can be grown anywhere in California. The native species, as mentioned in Chapter V, flourish from the sand of the ocean

beach to the rich valleys of the Sierra, just below the line of perpetual snow, and the deduction is that wherever fertile soil and sweet water can be brought together in California, the strawberry will reward the grower.

Strawberries do well on a variety of soils, but as a rule a deep, moist, loamy soil will yield best results. Boggy or swampy spots should be avoided unless drainage is provided, and in this way most excellent strawberry ground may sometimes be secured. Land which will produce good potatoes or corn will generally yield good results with strawberries—with or without irrigation, according to local conditions of rainfall, but a succession of crops during the season depends upon irrigation, as has been stated. It is the common experience that light, warm soils yield the earliest and highest-flavored berries, and heavy soils the later and larger ones; but the size of the berry depends more upon the supply of available moisture, and immense fruit can be produced on loose, open soils by free irrigation. And yet the heavier soil, both because of its usually superior fertility and retention of moisture, is preferred for the strawberry. The largest-producing regions for the San Francisco market in the Santa Clara and the Pajaro Valleys are comprised mainly of low-lying, heavy valley soils, naturally moist and rich, and furnished with abundant water supply for irrigation. Probably no grander berries can be grown anywhere than on our black adobe, but let it dry out and the plant might as well be set in a stone quarry, so far as summer growth and fruiting are concerned.

PROPAGATION OF THE STRAWBERRY.—Seedlings undertaken in the hope of originating valuable new varieties are easily grown by taking off the outside layer of the choicest berries, which carries with it the small, yellow seeds. Wash these from the skin and cover them slightly in a sandy soil partially shaded and kept moist by sprinkling, or a light mulch, and the plants are readily grown. As with seedlings of other fruits, few, if any, will be found superior to the parent variety.

Plants for setting out are secured by taking off the small growths rooted from runners. The strongest plants are those nearest to the parent plant. When these are allowed to root in small pots plunged into the soil, they are called "pot-grown," and are superior for planting out, but they are not largely used in this State. When plants of any variety are desired for new beds or fields, a row or more are allowed to send out runners during the summer, and these are fit for taking up and replanting the following winter or spring.

LAYING OFF GROUND FOR STRAWBERRIES.—The essentials are deep and thorough pulverization of the soil and grading of the surface so that water will flow slowly in the ditches. Suggestions as to location of grade lines may be found on pages 217 and 218. The inclination which answers for water distribution may be very slight; about two inches to the hundred feet answers on the level lands of the Pajaro Valley, while in the foothills much greater fall has to be made use of, and on hillsides rows located on contour lines and not in straight lines. A simple way to establish grade of three and three-quarter inches to the hundred feet is described by I. L. Dickinson, of Tuolumne County, as follows:—

> We prepare our ground for strawberries by plowing and grading so as to give a fall of about three-eighths of an inch to every ten feet, and in order to do this I made a level out of one-and-one-half-by-four-inch pine lumber. Take one piece ten feet long, and on each end put a leg sixteen inches long, and in the center of the ten-foot piece put a spirit level. Then to give the fall, tack on the bottom of one of the legs a three-eighths-inch block, and when this is set exactly level we have a fall of three-eighths of an inch to every ten feet. With this instrument we can run a ditch or lay off ground to irrigate around the bend of a hill, or sag, as we choose, and have the desired fall, and as correctly as a surveyor's level will do it.

Of course, in grading the field it is often necessary to give adjacent blocks opposite inclinations to provide for the return of the water. On hillsides, where the water is carried down a ridge to a flume, it is usual to keep the water always running away from the flume, and only enough is taken out to reach to the ends of the small ditches. A grade of six inches to the rod is practicable for hillside irrigation, but of course only a small flow of water is employed.

There are various ways for laying out strawberry beds and plantations. Some give flat cultivation and lay out in single rows two and a half to three and a half feet apart. Others lay out in double rows about two feet apart, and between each pair of rows the soil from the center is drawn up to each side, making a low ridge or level a little higher than the surface on which the plants are set. This levee serves as a walk between the beds and holds back the water upon the bed when irrigated by flooding. Another, and the generally-adopted plan, is to have the plants in double rows on a slight ridge, while between the beds is a furrow which serves as a walk and for irrigation. This is accomplished by throwing up the soil with the plow into ridges about two feet wide, with a double furrow between. On the sides of these ridges the plants are set, and often on the top of the ridge between the two rows of strawberries a single row of onions or lettuce, or some other vegetable, is grown the first year. In irrigation the water is drawn up from the trenches by

the roots and by capillary attraction, and the upper surface does not bake as it would by flooding if the soil be heavy. In hoeing out weeds and in fruit gathering, the workman walks in the ditch and does not pack the soil around the plant by tramping. This is the best method of laying out for large plantations. The rows are a uniform distance apart across the field, whether the space between be a ridge or a ditch. The method of making the beds a little lower than the general surface of the ground, answers best on free, open soils with perfect drainage. Cultivation can be reduced by covering the depressed surface of the bed with a mulch of fine, clean litter, such as chaff, cut straw, etc. This retains moisture and gives the berry a clean surface to rest on. Such a bed is an excellent arrangement for the home garden.

In all arrangements the plants are set at less distances in the rows than the rows are from each other. Probably the prevailing distance is one foot between the plants; the range is from eight to eighteen inches in the practice of different growers, and determined, of course, largely by the habit of the variety. A vine like the Sharpless, with a spreading growth and long fruit stems, needs, perhaps, the sixteen inches which some growers give it, while the smaller, more compact, Longworth Prolific may do well with half that distance, as this variety is commonly planted in the Santa Clara District, where it is still a favorite.

PLANTING STRAWBERRIES.—Strawberry plants are set out either in spring or fall, or at any time in the winter when the ground is warm and in good condition. In the drier parts of the State, early fall or winter planting is more essential than elsewhere. If the ground is dry, water should always be used in planting. This may be given by thorough irrigation of the ground before planting, or a little water may be used in setting each plant. At planting it is usually best to remove all leaves from the plant, shorten the roots to three inches or less, and be sure the plants do not dry while planting progresses. As with handling rooted grape-vines, it is advisable to carry around the plants in a vessel which has water in it. If plants have been received by mail, they are invigorated by soaking in water a few hours before planting.

In setting the plants, scoop out a little excavation with the hand or a trowel, spread the roots well, cover with fine soil, being sure that the crown of the plant shall not be below the surface when the soil is leveled. Too many strawberry plants are *buried*, not planted. Some plant very rapidly by using a dibble to make a hole, into which the roots are dropped and soil pressed

around them by using the dibble alongside; others set the plants on the side of the furrow, trusting to the next furrow to complete the covering. Nearly all ways succeed if the plant is not set too deeply and the ground is moist at planting and not allowed to dry out afterwards—providing good, strong plants are used. In buying plants it is often poor economy to buy the cheapest.

STAMINATE AND PISTILLATE.—In associating varieties be sure that pistillate varieties are not set by themselves. Some sorts have perfect flowers and are self-fertilizing; others have only the pistillate element in the bloom and must have the staminate adjacent in another variety. All the varieties largely grown in California have perfect flowers, though some pistillate sorts have been locally approved.

CARE OF THE STRAWBERRY PLANTATION.—Herein lies the secret of success with the strawberry. Neglect has led to disappointment and condemnation of the strawberry, where intelligent care would have rendered it a constant delight. The chief elements of proper care may be thus enumerated:—

Retention of moisture very near the surface by careful, shallow cultivation or by mulching, persistent destruction of weeds, and by compensating for summer evaporation by frequent irrigation.

Constant removal of runners from all plants except those it is desired to multiply to furnish new plants or to fill the rows. Pinching of runners should always accompany picking or hoeing of weeds, and on the garden bed there can be no excuse for neglect in this respect. The young plants should be faithfully freed from runners to strengthen them up for bearing.

Though, as already stated, strawberries may in some locations be had all winter, it is better practice, as a general rule, to lay the plants away for a rest. The market season in the regions supplying the San Francisco market extends from April to December, and fruit is continuously shipped during that period. At the approach of winter in the last-named month, it is usual to go over the beds with a sickle, cutting off the old crop of leaves close to the root crown, carefully cleaning up the plantation for the heavy rains. In most cases it will be a great advantage then to cover over all with a light coat of good manure, which the winter rains will leach down into the soils. The result of the fall clipping and enriching will be an early and strong start of the plant in the spring, and a most abundant fruitage.

DURATION OF THE PLANTATION.—Strawberry plants well cared for and not visited by insect pests, have a long, productive, and profitable life in California. Twelve-year-old plants at Santa Clara have been reported as still producing abundantly. It is customary to count from five to eight years as the profitable life of a plant, though some growers replant after two bearing years.

VARIETIES OF THE STRAWBERRY.—Though all new varieties are tried by California growers, and quite a number may be considered successful either for market or for home use, only a very few may be said to be widely grown. The three kinds which are pre-eminent in public favor are the Longworth Prolific, the Sharpless, and the Monarch of the West. The Sharpless is the most widely grown; the Monarch shows better size and color in Southern California and on the Sierra foot-hills than in the regions adjacent to San Francisco, although it is grown therein to some extent. The Longworth is an old favorite, early, productive, and hardy, and its style has become very popular in the markets. Wilson's Albany also holds favor in same. The Cinderella is largely grown in the Pajaro Valley. The Triomphe de Gand is approved in several counties; the Vick, Parry, Bubach, and about a dozen others might be mentioned as locally commended. It has been demonstrated that varieties show marked difference in behavior in different soils and situations. In planting for market or home use in new regions the planter will be safe in making his largest plantations of the varieties named above, and at the same time he should put out experimental plots of other varieties. The strawberry grower should continually maintain experimental culture; if he succeeds in getting one good variety for his locality, out of dozens of new sorts he may try, the effort will be profitable. In planting in established strawberry regions, secure the best available local advice, consulting a number of growers and forming decision from such evidence.

PART SEVENTH: NUTS.

CHAPTER XXXV.

NUT GROWING IN CALIFORNIA.

THE production of nuts has not yet risen to great prominence in this State. Though plantations of almonds and English walnuts were made quite early, there were many disappointments in thrift and fruitfulness, traceable, in most cases, perhaps, to the planting of defective varieties, or those unsuited to the locations chosen for them. The result has been that while some plantings have been notably successful and profitable, others have been counted failures, the English walnut trees going for firewood, and the almonds which did not take the same course being grafted over, chiefly into prunes and plums. Other nuts than these, except peanuts, have never attained great acreage, although, as will be shown, several have succeeded and promise to become popular.

The walnut has thus far only been produced in large quantities in Santa Barbara, Ventura, and Los Angeles Counties, and the product has been about one million pounds annually. Recent plantations will soon result in a great increase in the product. The almond product, which in some years amounts to five hundred thousand pounds, has been chiefly grown in central California. The failures of the almond at the South, and of the walnut at the North, seem now to be, probably, in part, at least, due to the unsuitability of the varieties which were tried, and not to lack of adaptation of the regions to the species. As other varieties of both nuts are now promising well, it is expected that the product of each will greatly increase in the future. Both our walnuts and almonds have won favor in Eastern markets.

THE ALMOND.

The almond has an interesting history in California, but it can be outlined in a few sentences. The importation of the best European varieties began very early, and a number of them had been planted in 1853. They proved irregular bearers, though the trees grew thriftily and in some cases showed fruit very soon after planting. Still the importation and trial of

varieties continued. Some were found satisfactory in some places but not in others. The conclusion was then reached that to secure regularity and abundance in fruiting, locations for almond orchards must be sought with the utmost care, and that the secret of success lay in the location. Within the last decade local seedlings have demonstrated their value in regular crops, and in characteristics and qualities superior to foreign kinds. They have proved profitable in situations where the Languedoc, the variety formerly most widely planted, is untrustworthy. The experience of the last thirty-five years then gives the basis for which present planting is proceeding, viz., that the choice of soil and situation, and the selection of trustworthy varieties, are both factors of success, but that possibly more lies in the choice of variety than of location, for the newer varieties are succeeding in situations which had been pronounced unsuited to the almond. Still it is very important to select locations for almond planting with due care.

Another fact which is likely to be of importance, though at present made but little use of, is that the Languedoc proves a better bearer if other varieties are grown with it, that it may enjoy the cross-fertilization of its blooms. The importance of association of varieties in this respect is being discerned in the behavior of some other kinds of fruit as well as almonds, but as yet it does not enter largely into planters' consideration.

SITUATIONS AND SOILS FOR THE ALMOND.—Almonds are now being planted on the higher lands in coast valleys, free from fogs and protected from direct winds, but subject to tempered breezes; also at various points in the interior valleys and foot-hills. Because of the superior hardiness and fruiting of new local varieties, as has already been described, it is impossible at present to state definitely what situations will ultimately prove desirable or otherwise. The general proposition that low lands in small valleys should be avoided, and bench or hillside situations preferred, seems to be a safe one. Lands directly upon the coast have not proved satisfactory.

The almond prefers a loose, light, warm soil, and heavy, poorly-drained soils should be avoided. Mr. A. T. Hatch, of Suisun Valley, the largest almond planter in the State, says: "The almond will not grow in the water nor do well in a heavy, poorly-drained place, but will flourish and produce good crops on soils that are too light or dry to grow peaches, apricots, nectarines, cherries, or similar pulpy fruit. Almonds will make better returns from leaner lands than any other product, except it may be vines, olives, or figs."

PROPAGATING, PLANTING, AND PRUNING.—The almond is propagated from seedlings grown as described on page 104, and

budded as described on page 110. The almond root is preferred, though the peach answers well. The apricot root should be avoided, for the reasons mentioned on page 257.

For planting out, trees in dormant bud are very successful if given proper care, as is described on page 298. Yearling trees do well, and usually those which have made a moderate instead of a very large growth are to be preferred. The almond makes a comparatively large tree and should have plenty of room —not less than twenty-four feet apart (though some plantations are made at twenty feet) and thirty feet is better.

The pruning of the almond is very simple. The tree should be headed low and pruned during the first three years, as described in Chapter XII, to secure a shapely, strong tree. After the third year little pruning is required except to thin out objectionable branches by winter pruning. Shortening in, as practiced with the peach, is not desirable with the almond.

The cultivation of the almond orchard is the same as commended for other fruit trees, and as the trees are often planted in naturally dry soils, the greater care in cultivation is needed to retain sufficient moisture to give good size to the nuts. In certain locations, of course, irrigation will be necessary, but usually very light rainfall will answer if good cultivation is given.

GATHERING, HULLING, AND BLEACHING.—Almonds are gathered by spreading canvas under the tree and shaking the branches separately; the few nuts remaining can be displaced by striking with a light stick. The gathering should be done after the hulls have burst open, but should not be delayed until the nuts are badly discolored.

Hulling is done with machines devised for that purpose. J. Hobart, of Nordhoff, Ventura County, has invented one which works admirably. Another is manufactured by A. O. Rix, of Irving, Alameda County, according to a plan suggested by Henry Curtner, a large almond grower of Harrisburg. It consists of a grooved iron roller and a set of bars arranged with reference to the roller, as the concave is to the cylinder of a threshing machine. Each of these bars is supported behind by a spring at each end, so that each works independently of the other, and yields a little if an extra large nut strikes it. At first the concave bars were set solid, and the result was the breaking of many nuts, but supporting them by the springs overcomes this completely, and hardly any nuts are broken. The machine runs by hand crank, and requires but little effort to hull a sack in two or three minutes. The roller and concave bars are sixteen inches in length, but the same principle could be applied to a large machine to run by horse-power or steam.

Bleaching is apparently demanded by market requirements. Sulphur is used and should not be applied until the nut is thoroughly dry, or else the fumes will penetrate it, and not only spoil its flavor, but if used to excess will destroy its germinating power. The nuts are dried by exposure to sun on platforms or trays, and in dewy places should be covered during the night. After being well dried, sprinkle the nuts sufficiently to moisten the shell surface and apply sulphur fumes. Various home-made contrivances are used for bleaching, such as piling up several of the slat-bottom trays one upon another, placing around them sides made of boards so as to hook together at the corners, cover the top with a damp canvas, and burn the sulphur in a hole in the ground below the bottom tray.

Webster Treat, of Davisville, a large grower of almonds, describes his sulphuring-house for almonds:—

> My bleaching-house is about twenty-five feet by eight feet, and I generally put in about four thousand pounds of almonds, and expose them to sulphur fumes for three or four hours. The house is boarded with tongue and groove flooring, inside and out, and roofed with well-laid shingles, and a flue about two feet high on the apex, to help draft the sulphur smoke up. The floor is of one-by-three-inch stuff, set up edgewise, three-eighths of an inch apart, or just wide enough to admit the fumes from the sulphur burning below, and narrow enough to prevent the nuts from falling through. The floor is about two and one-half feet above the ground, and the lower space is boarded up with tongue and groove also, and fitted with small doors every five feet, so that the sulphur pans can be placed underneath the floor.

Care should be taken to burn the sulphur without much fire, so as to avoid high heating. The sulphur fumes are applied until the nuts are of a light yellowish color; the proper shade is to be learned by securing approved samples from some trustworthy dealer.

DESIRABLE POINTS IN TREE AND NUT.—Mr. Hatch says: "Almonds, to pay the grower, should bear well every year, hull easily, have clean, thin, soft shells, and a smooth, bright, and plump kernel. They do better out of the fog than in it. Almonds with long, single kernels are preferred in general to those which have double ones." A part of these characteristics are due to variety, and part to locality. Situations with excessive atmospheric moisture seem to favor adherence of the hull or discoloration of the shell, but some of the new seedlings are practically free from these objections, even where the older varieties exhibit them. Some of the new varieties are also claimed to be less liable to injury by red spider, which is a great pest of the almond generally.

VARIETIES OF THE ALMOND ORIGINATED IN CALIFORNIA.—The leading propagator of new almonds is A. T. Hatch, of Suisun, and his varieties have attained such prominence that the following account of their origin is given. In 1878 Mr. Hatch

planted out about two thousand five hundred seedling almond trees grown from bitter almond seed. He afterward budded all the seedlings but about three hundred, which were left to bearing age unbudded. The fruit of these seedlings was of all degrees of excellence. A collection of them was shown at the New Orleans Exposition, where a premium was secured. At the Citrus Fair in Sacramento, in 1886, Mr. Hatch showed one hundred and ninety-two varieties. Of the vast numbers of distinct varieties secured, four have been selected for propagation, viz., the "IXL," "Ne Plus Ultra," "Nonpareil," and "El Supremo." The nuts have sold in Chicago at exceptionally high prices, and careful tests of the weight of the kernels as compared with the gross pound of the nuts of several kinds gave this result: Imported Tarragona, six and one-fifth ounces of kernels; California Languedoc, seven and one-half ounces; Hatch's Nonpareil, eleven ounces; Hatch's El Supremo, thirteen ounces.

Excellent seedling almonds have also been produced by other growers. The following list includes the sorts most widely grown:—

IXL.—"Tree a sturdy, rather upright grower, with large leaves; nuts large, with, as a rule, single kernels; hulls easily, no machine being needed, nor is any bleaching necessary; shell soft, but perfect. It bears heavily and regularly."—*A. T. Hatch.*

NE PLUS ULTRA.—Large and very long in shape; heavy and regular bearer; soft shell; hull free.

NONPAREIL.—First called *Extra.* Of a weeping style of growth, smaller foliage than the IXL, but still forms a beautiful tree. An extraordinarily heavy and regular bearer, with very thin shell, of the Paper Shell type.

LEWELLING'S PROLIFIC.—Originated with the late Mr. John Lewelling; "tree a great bearer; of drooping habit; nut large and good; soft shell; huli free."—*Leonard Coates.*

HARRIOTT'S SEEDLING (or *Commercial*).—A new variety from Visalia, where it is said to be a sure cropper; shell softer than the Languedoc; nut long, of peculiar shape, quite large; kernel sweet.

KING'S SOFT SHELL.—Originated in San Jose; shell very thin and soft; regular and abundant bearer.

LANGUEDOC.—Nut large; shell thin; kernel sweet.

PAPER SHELL.—Medium size; shell very tender, easily broken between the finger and thumb; kernel large, white and sweet.

DRAKE'S SEEDLING.—Originated with Mr. Drake, of Suisun; of the Languedoc class; very prolific, and a regular, abundant bearer.

BRIER'S LANGUEDOC.—Originated with the late Rev. W. W. Brier, Centerville; medium size; soft, light-colored shell; sweet and delicate flavor; good bearer; blossoms resist quite severe frosts.

MCCOY.—Originated near Suisun; rather small and hull adheres, but a regular bearer.

ROUTIERS NEW LANGUEDOC.—A new seedling from J. Routier's orchard near Sacramento; *fac-simile* of Languedoc, except that the shell is a little softer; tree moderately strong grower and prolific.

BEARING DATE PALM OF MRS. S. C. WOLFSKILL.—See page 405.

ROUTIER'S SOFT SHELL.—Shell quite soft, but not soft enough to crumble; tree moderately strong grower, very prolific.

ROUTIER'S TWIN ALMOND.—Large, smooth nuts, all with double kernels; shell soft as Languedoc; tree hardy and a good bearer.

BLOWER'S LANGUEDOC.—Grown by R. B. Blowers, of Woodland; fine nut; tree good and regular bearer.

GOLDEN STATE.—Originated in Oakshade orchard, Davisville, and described by Webster Treat as a large soft shell, somewhat longer than the Languedoc, with a full, smooth-skinned meat; it parts from the hull readily, and, if left on the tree, drops out of itself. It ripens four or five weeks earlier than the Languedoc and the Tarragona.

CALIFORNIA.—A paper-shell highly commended by Webster Treat as an early, regular, and heavy bearer, and producing a very desirable nut, which has sold at exceptionally high prices at Chicago.

THE JAPANESE CHESTNUT.

THE CHESTNUT.

The chestnut is not yet produced in large amount in California, and certain quantities of the nuts are annually imported, the American, Italian, or Spanish and Japanese all being found in the San Francisco markets. Of chestnuts grown in California, the Italian predominates, and the Japanese is more common than the American, which is slow of growth and late in fruiting, as compared with the other kinds. Judging by the success of the Italian, it may be said that a large area of California is well suited for the growth of the chestnut, as there are bearing trees in nearly all parts of the State. The chestnut succeeds on heavy, clayey soil, even if it be quite rocky. In Berkeley a tree six years from the seed attained a height of fifteen feet and bore staminate blooms.

Chestnut trees are readily grown from the seed, and thus grown come into bearing in from six to eight years, though the Japanese sometimes bears sooner. The growth of chestnuts from the seed is described on page 105. In growing from seed of the improved varieties, there is a tendency toward reversion, and budding and grafting may be resorted to; budding is done by the ring method, as described on page 415. The chestnut can also be grafted with the ordinary cleft graft. Buds or scions should be taken from trees which are fruiting satisfactorily, and in this way seedlings which have a tendency to bear empty burs can be turned to good account. Chestnuts can be grown in the nursery until several years old, providing they are lifted at the end of the first year, the taproot cut off, and the trees reset, giving them rather more room than during their first year's growth. In permanent plantings the trees should have plenty of room, as they ultimately attain great size. Mr. R. G. Sneath reports seeing trees at Grass Valley, Nevada County, about twenty years old, which are fifteen inches in diameter of trunk, and forty feet high, and reported to be bearing a barrel of nuts to the tree regularly. Felix Gillet, of Nevada City, has for many years made a specialty of propagating a large collection of the improved French varieties of the chestnut, known as *Marrons*, the two engravings given herewith being of nuts grown in California.

MARRON COMBALE.

The chestnut, aside from its desirability as an orchard tree, can be commended as a tree for hillsides or a shade tree for waysides or pastures, and should be more widely planted in California.

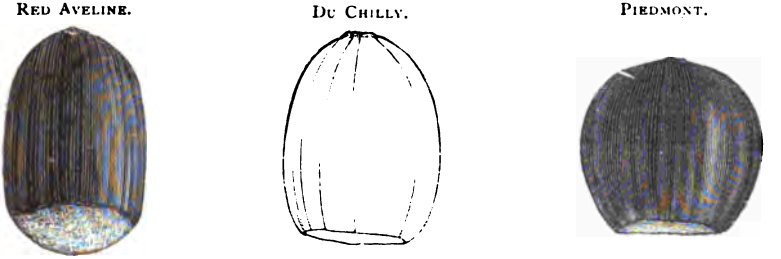
THE FILBERT.

Improved Spanish and French varieties of the Filbert were early introduced into California by Felix Gillet, of Nevada City, and have been favorably reported by him as to growth and bearing. A collection of the best English cob-nuts was introduced by Leonard Coates. and planted in the Napa Valley, where their bearing was not satisfactory. The experience of Mr. Coates is like that of other growers in the valleys, which, so far as known to the writer, is unfavorable to the planting of the nut, because of failure to bear well-filled nuts. As stated on page 62, the success of the prop osition to graft the improved filberts upon our wild hazel-nut, has not been demonstrated. It is possible, however, that the improved varieties might do better if planted on the north slopes of the Coast Range, and in other cooler and moister situations, as well as at an elevation on the Sierra foot-hills, where Mr. Gillet pronounces them satisfactory. Failure to fruit is, however, the common verdict, even in what would seem to be favorable situations. The nuts produced by Mr. Gillet, of which engravings are given, are certainly of high excellence, and they would be profitable if trustworthy crops can be secured.

MARRON DE LYON.

The choice filberts are propagated by suckers, or layers, or by grafting on seedling roots. The seedlings revert to the wild

RED AVELINE. DU CHILLY. PIEDMONT.



IMPROVED EUROPEAN FILBERTS GROWN IN CALIFORNIA.

type and are also slower in bearing. Of the varieties shown, the Red Aveline is a delicious nut, which Mr. Gillet has fruited for sixteen years, and finds most prolific of his collection; the Du Chilly is the largest nut he has grown, and the Piedmont is

also prolific and excellent. The filbert commends itself to experimenters, that its adaptations may be better determined.

THE PEANUT.

During the last few years the peanut product of California has notably increased. Previously the nuts were only grown by Chinese along the upper Sacramento River, but at present the crop is a popular one in some parts of the San Joaquin Valley and Southern California. The nuts are considerably grown between the rows in young orchards and vineyards, as well as upon ground wholly given to them. The following explicit directions are given by R. M. Hargrave, a grower in Orange County. Some slight modifications in practice may be needed, according to locality, as, for example, in time of planting, which is usually a little earlier than the date given:—

PLANTING.—The best time to plant peanuts is about the middle of May, say 10th to 15th, in rows about three to four feet apart, and sixteen to twenty inches the other way, and not cover too deep, three or four inches. Peanuts planted the middle of May ripen evenly and are of uniform size. Very early peanuts ripen unevenly, and the first nuts that set on get so ripe they turn to a pink color, and if the land is a little sandy the stems get soft, lose their strength, and will not lift the nuts from the ground.

It takes about thirty pounds of the California or White Virginia, and fifty pounds of the Tennessee Reds to plant an acre. Tennessee peanuts can be planted much closer in the rows. The California peanut is the best to plant, as it yields three or four times as much as the Tennessee Reds do, and has more ready sale.

THE QUALITY OF LAND.—Peanuts require a rich, sandy soil loam, that is known as upland. Damp land gives the nuts a straw color, and they are not as good a quality as those raised on higher land. They require no irrigation, except on very sandy land, where some have found it profitable, but as a usual thing when irrigated the ground is liable to get hard, making the nuts crooked, ill-shaped, and many times coloring them.

CULTIVATION.—Peanuts should be cultivated about the same as corn, not allowing any weeds to grow in them, keeping the ground loose and mellow, and when the spikes begin to form, they should not be disturbed. If they are, it causes the nuts to blight or not fill out. The blooms do not require to be covered.

HARVESTING.—Peanuts should be harvested when ripe, and not allowed to stand too long, in hopes that the last ones set out will fill out and ripen, as you lose more than you gain. The little ones spoil the sale of the crop, and many are left in the ground that get over-ripe. Peanuts should be cut or plowed out and thrown into windrows, nuts down, and let lie a week or ten days, and then sacked, as the best nuts are cured in that way and they do not mold so badly, and cure a better color. They must not be allowed to get wet. The tops are good feed if stored away in a shed for winter use. All kinds of stock like them, and small nuts can be left on the vines. They make the best chicken feed.

YIELD.—An average yield is about twenty-five to thirty sacks to the acre, forty pounds to a sack, but many have raised fifty sacks, with extra care and good land well adapted to peanuts. Five cents per pound is a fair price for good nuts, making a revenue of from $40 to $100 per acre.

THE PECAN.

The pecan, by rapid growth, early fruiting, and general thrift, seems to be the member of the hickory family best fitted for

California conditions. A tree of the shell-bark hickory grown from a nut planted by J. R. Wolfskill, on Putah Creek, in 1865, attained a height of about twenty feet in 1888, and bore a few nuts in 1886; a pecan tree from a nut planted in 1878 was, in 1888, more than twice the size of the hickory, though much less than half its age, and had borne two or three crops of nuts.

The pecan has been grown for a number of years merely in an experimental way, and trees can be found in many parts of the State; the largest trees known to the writer are on Rancho Chico, and have attained a height of about fifty feet. There are trees of similar size in Visalia, from nuts of which many seedlings have been grown. As yet, California has no marketable product of pecans to speak of, but within the last few years larger plantations have been made.

Pecan trees grow readily from the nuts if these are fresh. Planters should secure nuts of selected varieties (for there is a great difference in size and quality) direct from growers in the Southern States, and plant as soon as received in the early winter, or if conditions are not favorable for planting, the nuts should be stored as described on page 105. Nuts planted in good nursery ground in rows as suggested on page 108, and covered about two inches or a little deeper in dry, loose soil, and then mulched to retain moisture, will germinate freely. The trees should be transplanted to permanent place at the end of the first year, and then usually the taproot can be retained, as some growers deem very desirable; if the trees are to be put in permanent place later, they should be transplanted in the nursery and the taproot cut off. The nuts can, of course, be planted at once in permanent place if one will take the extra trouble necessary to properly care for them.

The pecan usually comes into bearing in California at from eight to ten years from the seed, and, so far as experience goes, bears regular and satisfactory crops. There is, however, in some localities, complaint that the nuts do not fill properly.

THE PISTACHIO.

The pistachio nut *(pistachia vera)* has been grown experimentally in this State for several years. The species upon its own root makes a low shrub and is very slow of growth. We have also imported the *pistachia terebinthus*, from which is derived the "chio turpentine," and which is the stock upon which the true pistachio is grafted in Europe. It is a very hardy tree, the largest specimens probably being on the Rixford ranch, in the Sonoma Valley, where they have attained a height of twelve to fifteen feet on a heavy adobe soil without irrigation. Nuts

have been produced and will be used to grow stocks for the true pistachio. The pistachios are dicœcious and need association of staminate and pistillate trees, about one of the former to twenty of the latter. It seems likely that erelong a commercial product of pistachios may be attained in California.

THE WALNUT.

The qualities of the native black walnut are mentioned on page 61. The American black walnut has been introduced but does not seem to relish the conditions so well as the local species. The nut which is signified in California when the term walnut is used, is the English walnut or Madeira nut (*Juglans regia*) and its many varieties.

This tree makes a grand growth in California. Specimens can be found here and there, which, at about twenty years of age, are from fifty to sixty feet in height, with a spread of branches of forty to sixty feet, and in some cases bearing four to eight hundred pounds of nuts. Such trees can be found in the rich valleys of both Northern and Southern California, but, as has already been stated, the English walnut has thus far been produced in large quantities only in regions adjacent to the coast in Southern California, though there are promising plantations farther removed from coast influences. The equable temperature of the Southern coast seems, however, to specially favor the nut. The variety chiefly grown at the South, and which, for want of a better name, has been called the "Los Angeles Seedling," suffers both from frost and sunburn in the interior valleys, and from frost in Northern coast valleys as well. A number of French varieties, which were introduced many years ago and have been widely enough distributed to test their growth, have been found to thrive in many situations where the Los Angeles variety is a failure, and there is at present quite a disposition to larger plantings of the walnut, as a sole occupant of the land or as border trees around fruit orchards. At the South the walnut area is increasing considerably in those situations where the tree shows most satisfactory bearing qualities. In the South new varieties of California origin are being chiefly selected. In all untried places, or in all places where the walnut has failed, trial should be made of the hardy French varieties, which will be described farther on.

SOILS FOR THE WALNUT.—The walnut makes most rapid growth upon a deep, rich, moist, loamy soil, and shows its appreciation of good things of the earth as do other fruit trees, and yet it attains satisfactory size and bearing in less favorable

situations. Thriving trees can be found in the clays and decomposed granite soils of the foot-hills, as well as in the valley silts and loams. Adequate moisture must, however, be had, and the walnut cannot be commended for dry, neglected places.

PROPAGATION.—The walnut tree grows readily from nuts treated as described on page 105 and following pages. In the main the use of seedlings prevails, and the nut is usually considered to come true from seed. Excellent results have, however, been obtained by using the California black walnut as a stock for the English walnut, and in that case budding or grafting must be resorted to. Many instances of the success of the English walnut on our native stock might be cited, but the most notable tree known to the writer is to be seen on the grounds of John R. Wolfskill, on Putah Creek, in Solano County. He put in a bud in 1875 and growth started the following year. In 1888 the tree was about fifty feet high and sixty feet in spread of branches, and bearing two hundred pounds of nuts annually.

In working on the native California seedling stocks, Mr. Clowes, of Stockton, buds by the common method, removing the wood from the inside of the plate of bark, as advised for the orange on page 457. Twig buds as used with the olive (see page 431) are also successful, and ring budding (see page 415) works well.

Mr. Gillet's latest conclusions concerning annular budding of the walnut is that it should be done upon shoots of a year's growth, and those which have at least attained the thickness of the middle finger. The buds should also be set at the base of these shoots where the wood is perfectly round. The bandage should pass above and below the bud so that the bark under it may be pressed down close upon the stock, and this is more surely gained by shaving off the base of the leaf stem, below the bud, about to the point where it would separate when the leaf naturally falls off.

Large walnut trees can be worked over either by budding or grafting. If by budding, the large limbs are cut back in the winter, and in August following, ring buds are put on as many of the new shoots as may be desired. In grafting, the common cleft graft is used, but the split should not be made through the pith, but at one side; the scions should be whittled so as to show as little pith as possible. This is done by cutting down to a point at one side and not in the center of the scion. Care should be taken to cover all exposed surfaces. Grafting over in this way is desirable either for substituting a better variety of English walnut, or for working over a California black walnut into an English variety.

PLANTING WALNUT ORCHARDS.—There is much difference in practice in planting out walnut trees in permanent place. Some advocate the use of trees two or three years from the seed, getting as much of the taproot as possible; others allow the tree to remain in nursery until it throws out laterals, which is usually done the fourth or fifth year. The extreme practice is that of Russell Heath, of Santa Barbara County, who does not transplant from nursery until the tree has attained bearing age, at eight years or more from the seed, and he has successfully moved ten and eleven-year-old trees, trenching all around the trees, at two and a half feet from the stem to a depth of four feet, and cutting back to eight or nine feet high, removing all laterals. This is an expensive operation, costing, perhaps, three times as much as transplanting three-year-old trees, but Mr. Heath advocates it because of the saving in the cheapness with which trees can be properly cultivated in nursery up to bearing age as compared with the cost of cultivating orchard. This wide difference in local experience shows that the walnut may be safely transplanted at almost any age if the work is carefully done. The distance at which walnut trees are set is usually forty feet in squares, though some give the larger growing varieties fifty feet.

INTER-CULTURES WITH THE WALNUTS.—In the Southern walnut regions it is common to grow beans, squashes, etc., between the rows of trees until the latter reach bearing age; root crops which attract gophers should be avoided. Inter-planting of smaller, early-fruiting trees is also advisable, as mentioned on page 126.

PRUNING THE WALNUT.—The walnut is usually headed higher than ordinary orchard trees. All the pruning needed is in shaping the tree as described for the fig on page 418. Upward trend of the branches should be secured, sometimes by cutting out the shoots which grow downward, sometimes by propping or tying them up for a time. Mr. G. W. Ford says:—

> Pruning the walnut is of but little trouble. When planting, do not cut the top off, as is done on other deciduous trees, but leave the main trunk for the center. Prune up to three or four feet (not too high), for the bark of a walnut tree is easily sun-burned, so it is necessary for the foliage and lower branches to shade the trunk.
>
> If the lower limbs extend outward and are in the way of the cultivator, tie them up to the trunk, for by so doing you can train the lower branches upward so as to cultivate close to the tree, and when the orchard comes into bearing, the limbs growing upward will not bend down to the ground with the fruit, so you can't get within twenty feet of them with a cultivator.

The stem should be protected from sunburn until the foliage accomplishes this. Whenever shoots are killed back by sunburn or by frost, they should be cut off cleanly below the black mark

which shows how far the injury has extended. If this is done, the die-back down the branch is usually prevented.

BLOOM AND BEARING OF THE WALNUT.—The walnut has its staminate and pistillate blooms separate, but both occur on the same tree, as shown by the engraving of a twig with both associated. All the buds marked *a* are staminate, and will develop into catkins, shown in Fig. 2. The terminal buds *b* are pistillate and will develop into embryo nuts, each bearing a

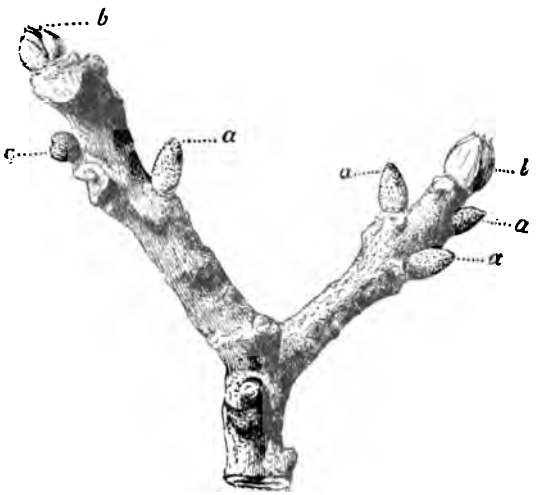


FIG. 1. STAMINATE AND PISTILLATE BUDS OF THE WALNUT.

FIG. 2. CATKIN OF THE WALNUT.

little branched plume-like pistil, as shown in Fig. 3. The bud marked *c* in Fig. 1 is a leaf bud.

FIG. 3. PISTILS AND EMBRYO NUTS.

Successful fruiting depends upon the simultaneous appearance of these two forms of bloom, and the lack of bearing of some varieties has been found to be due to the fact that the catkins disappeared before the pistillate bloom was sufficiently developed to receive the pollen.

The bearing age of the walnut depends upon the variety. Some of the French varieties now grown here are very precocious and have borne fruit in nursery row at two and three

years old, but the pistillate blooms were then fertilized from catkins growing on older trees. The practical bearing age of the English walnut in this State may be rated at six to eight years, according to the variety.

Gathering walnuts is done in different ways; some gather them from the ground at intervals during the months of September and October; others use poles and clean the trees at one operation; some go over the ground three times; first, picking up what have fallen; second, picking up what have fallen, and striking the limbs lightly to dislodge others which are ripest; third, picking up again and then knocking off all that remain on the trees. In this way gathering lasts a month or six weeks. Walnuts after gathering are sometimes washed to remove dirt, etc., but in all cases are subjected to a drying process before storing. This is done by exposure to the sun, or in a drier. Mr. Joseph Sexton, of Santa Barbara, uses elevated platforms made of narrow boards, with spaces of one-fourth of an inch between each board. The platform should be about eight feet wide and forty feet long, or as long as two men can handle a canvas to cover the beds, which should be done every night the dew falls. The nuts are stirred once or twice each day, and with favorable weather they will dry sufficiently in three days. For drying on a large scale near the coast, an artificial drier is found desirable by Mr. Heath, of Carpenteria, who has an apparatus of large capacity in which he dries his walnuts sufficiently by eight hours' exposure to the heat.

Walnuts sometimes have to be bleached to suit customers. The process is the same as has been described for almond bleaching, and is open to the same objections.

VARIETIES OF THE WALNUT.—Of walnuts of California origin, there are two classes, which are called "hard" and "soft" shell, and there is some difference of opinion as to their comparative value. Mr. Heath protests against the term "hard shell," and describes them as "medium shell" and "soft shell," and maintains the superiority of the former. Others are just as firm in advocacy of the soft shell, and it has the advantage in point of popularity, being now much more largely propagated by Southern California nurserymen. Several varieties of French walnuts are now being widely distributed. An attempt will be made to give some of the distinctive points of each variety mentioned:—

COMMON ENGLISH WALNUT; *Los Angeles nut, etc.*—This is the ordinary English walnut of commerce. It was planted at an early day in Los Angeles County, and has been widely distributed. It is considered by Mr. Russell Heath, of Santa Barbara County, as more desirable than thinner-shell kinds, because the shell is not

too thick to be broken with the fingers, and firm enough to avoid breakage in shipping. It comes into bearing at eight years of age, and in certain situations bears abundantly. Its behavior elsewhere is described by Mr. W. B. West, as follows: "The Los Angeles seedling is a very unreliable tree, only giving fruit under the most favorable circumstances in Northern California; it grows very thriftily when young, but does not ripen its wood sufficiently to withstand the severe winters that we sometimes have, and if, by chance, a series of mild seasons follow the planting, and the tree attain a good size, it is unfruitful, and seldom pays for the room it occupies." Even at the South, as already stated, this variety is being rejected by planters in favor of the soft shell, which is claimed to be a more regular bearer.

SANTA BARBARA SOFT SHELL; *Sexton's Soft Shell.*—Originated by Joseph Sexton, who gives this account of its origin and characteristics: "The winter of 1867 I bought in San Francisco a large sack of English walnuts. I raised about one thousand trees that season, and planted two hundred of them the following spring, in orchard form, at Goleta. Sixty of them proved to be the soft-shell variety. The soft shell is a little later in starting in the spring than the common nut, and blooms about ten days later. It commences to fruit at six years old from the seed, and some have been known to fruit as young as the fourth year. My trees have produced full crops each year for the past fourteen years. The hard shell commences to fruit about the ninth year, and bears full crops alternate years. The soft shell is not as strong a grower as the other walnut; it being so prolific retards its growth, and at the same age—taking a number of years together—it will not produce as much fruit per tree as the hard-shell variety, and at the same price it would not be as valuable a tree to plant. But the trees can be planted together, and the price can be made so much more that it will be the most valuable tree to plant. It is a superior nut, and when better known will be pronounced so by all. The kernel is white, and better for confection and for all other purposes. The shell is thin, rendering them easily broken by the hand, at the same time strong enough to bear transportation to any part of the United States." The behavior of this variety in the northern part of the State has not been determined.

FORD'S IMPROVED SOFT SHELL.—G. W. Ford, of Santa Ana, is propagating an "improved soft shell," gained by selection from the variety of Joseph Sexton, which is proving very prolific and profitable in his region.

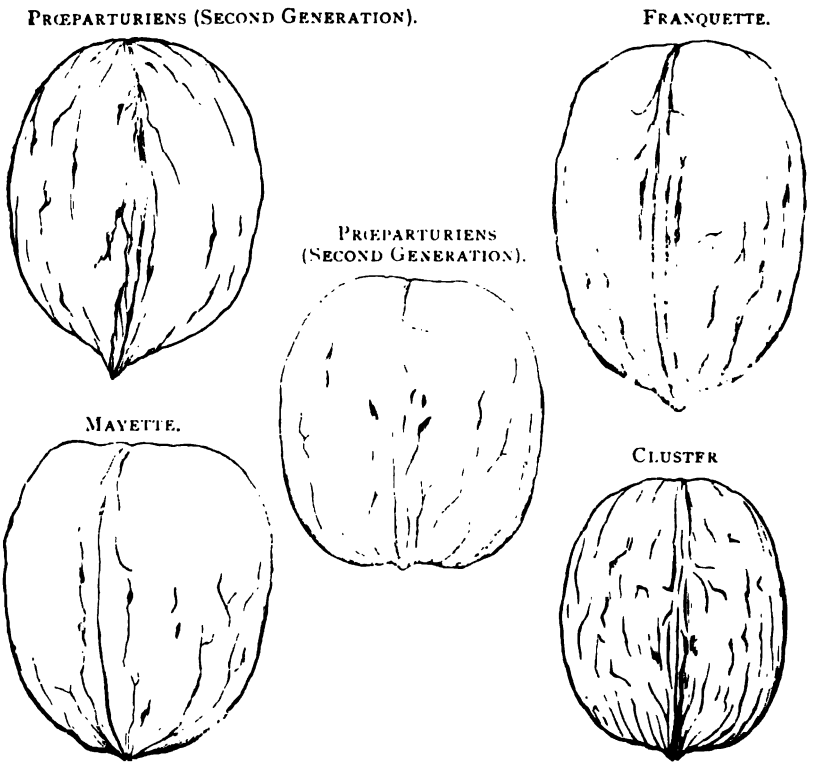
FRENCH VARIETIES.

Of the general behavior of this group of varieties as compared with the common Los Angeles seedling, Mr. W. B. West writes: "Their growth is slow and the wood ripens fully. I have never lost an inch of wood from any frost that has occurred since they were planted, while the Los Angeles trees, near them, have been cut to the ground many times. As to the quality of the nut, there can be no difference of opinion—the French nuts are decidedly superior, the shell is thinner, and the meat is very sweet and rich, with none of the bitter skin which always accompanies the Los Angeles kind." Mr. West especially commends for the San Joaquin Valley and foot-hills the following, which have proved prolific and profitable on his place at Stockton: Bijou, the largest walnut grown, an early and free bearer; Præparturiens, very satisfactory, bears very young, and never injured by spring frosts; Seroting, a late variety, especially adapted for frosty places; Mayette, large and excellent; Chaberte, thrifty and hardy.

PRÆPARTURIENS.—This famous French variety was introduced in California in 1871, by Felix Gillet, of Nevada City, and has since then been brought in by other parties, and is now widely distributed. Its chief characteristic, as its name indicates, is early bearing, but the tree does not practically come into bearing, that is, produce its own staminate and pistillate blooms, until about eight or nine years of age. The variety blooms from two to four weeks later than the common Los Angeles seedling; it shows both kinds of bloom simultaneously, and has the characteristics mentioned by Mr. West, of ripening its wood well, and high quality of the nut. Mr. Gillet claims that only the trees grown from seed from the original tree in France or trees grafted from that, will show the highest excellence, and these he calls "second gen-

eration" trees; after that there is a pronounced tendency to reversion to the common type. The engravings given herewith are from nuts grown in California on a "second-generation" tree, by Mr. Gillet. The Prœparturiens is also sold in this State under an Eastern name, "dwarf prolific;" the tree is evidently not a dwarf in the usual acceptation of the term, though it probably will not attain the size of the common walnut. Nearness to Prœparturiens trees has sometimes made unproductive Los Angeles seedlings fruitful.

OTHER FRENCH VARIETIES.—Quite large collections of French varieties other than Prœparturiens have been introduced by Mr. Gillet and others, and specimens of some of the nuts grown by Mr. Gillet are shown in the engravings. The Cluster walnut fruits, as its name indicates, in long bunches, sometimes as many as fifteen in a

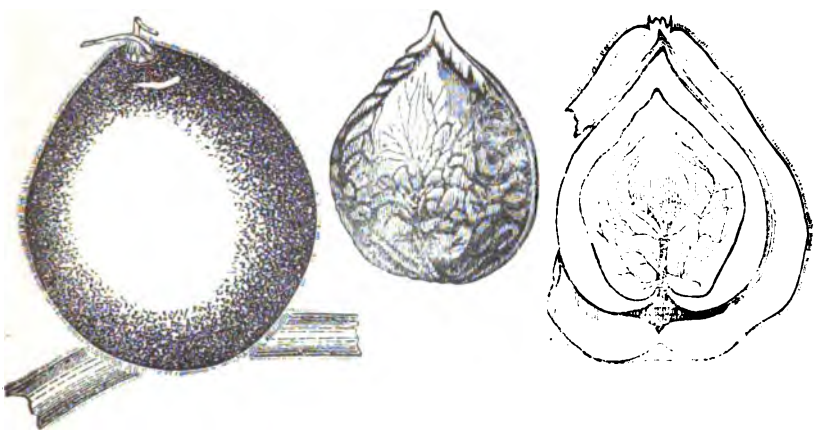


FRENCH WALNUTS, CALIFORNIA GROWN, BY FELIX GILLET.

bunch; otherwise the tree resembles the common English walnut. The Mayette is a large, full-fleshed, and sweet nut, very late in budding out in the spring, and suited for frosty places. The Franquette is a very large elongate-oval, blooms late, and is commended for size and quality of the nut. The Parisienne is a beautiful variety, the nut large, broad, and shapely; the tree blooms very late. All the foregoing varieties and the Serotina, Barthere Mesange, Gant, and Chaberte were introduced by Mr. Gillet, in 1871. Recently he has added to his collection the Vourey, Meylan, Vilmorin, and Weeping walnut.

PERSIAN WALNUT.—A variety called Persian walnut, or Kaghazi, has been grown and propagated for several years by James Shinn, of Niles, who describes it as follows: "Very much larger than the ordinary kinds, and thinner shelled. The tree is late in putting out leaves and blossoms, and is, therefore, especially good for places that are in danger of late frosts."

JAPANESE WALNUT; *Juglans Sieboldiana.*—This species, native of the north of Japan, was introduced to California about 1860, and a tree grown from seed planted about that time is growing at the Tower House, in Shasta County. For a number of years it was admired for the beauty of the tree, and appreciated for the desirability of its fruit, but its identity was unknown until its determination in 1881, by Mr. G. P. Rixford, to whom the question was referred by the State Horticultural Society. A full description is given in the *Pacific Rural Press*, January 8, 1881.



THE JAPANESE WALNUT—GROWN IN CALIFORNIA.

The trees were first catalogued by R. J. Trumbull & Co. Recently the good points of the tree have been more widely recognized The following excellent description is by Luther Burbank, of Santa Rosa: "This species is found growing wild in the mountains of Northern Japan, and is, without doubt, as hardy as an oak. The leaves are of immense size, and a charming shade of green. The nuts, which are produced in extreme abundance, grow in clusters of fifteen or twenty, have a shell thicker than the English walnut, but not as thick as the black walnut, very much resembling pecan nuts. The meat is sweet, of the very best quality, flavor like butternut, but less oily, and much superior. The trees grow with great vigor, assume a very handsome form, need no pruning, mature early, bear young, and are more regular and productive than the English walnut. No tree on my grounds has attracted more attention than the Japan walnut."

PART EIGHTH: FRUIT PRESERVATION.

CHAPTER XXXVI.

FRUIT CANNING, CRYSTALLIZING, AND DRYING.

THE preservation of fruit in various ways for home use and distant shipment, is one of the leading industries of California, employing a large amount of capital and labor, and distributing a vast amount of money among our people. These facts can be best emphasized by statements of the product of 1890, in the leading methods of preservation, by canning and drying.

CANNED FRUIT PRODUCT OF 1890.*

	Cases.
Table fruits, 2½-lb. cans, two doz. per case	1,375,000
" " 1-gal. " one " "	12,000
Pie fruits, 2½-lb. " two " "	32,000
" " 1-gal. " one " "	47,000
Jams and jellies, 2-lb. cans, two doz. per case	32,000
Total.....35,952,000 2½-lb. cans, or	1,498,000

This product was the output of about twenty-five canning establishments, located in different parts of the State.

DRIED FRUIT PRODUCT IN POUNDS.

	1888.	1889.	1890.
French prunes	2,000,000	15,000,000	18,000,000
German prunes	100,000	200,000	200,000
Apples, sun-dried	100,000	100,000	200,000
Peaches, sun-dried	2,000,000	500,000	200,000
Plums, sun-dried	200,000	300,000	500,000
Pears, sun-dried	25,000	50,000	200,000
Grapes, sun-dried	2,000,000	1,500,000	8,000,000
Nectarines, sun-dried	100,000	.....	.....
Apricots, sun-dried	100,000	.....	.....
Figs, sun-dried	75,000	100,000	200,000
Apples, evaporated	250,000	400,000	600 000
Apricots, bleached	2,500,000	2,000,000	6,000,000
Peaches, bleached, pealed	400,000	200,000	200,000
Peaches, bleached, unpeeled	2,200,000	3,000,000	4,600,000
Plums, bleached	40,000	.....	.....
Nectarines, bleached	60,000	200,000	400,000
Totals	12,150,000	23,550,000	39,300,000

*Estimate of Cutting Packing Company, of San Francisco.

Add to this the weight of raisins, which is approximately forty million pounds,* and the total weight of the California fruit product, canned and dried, is above one hundred and fifty million pounds.

THE CANNING INDUSTRY.

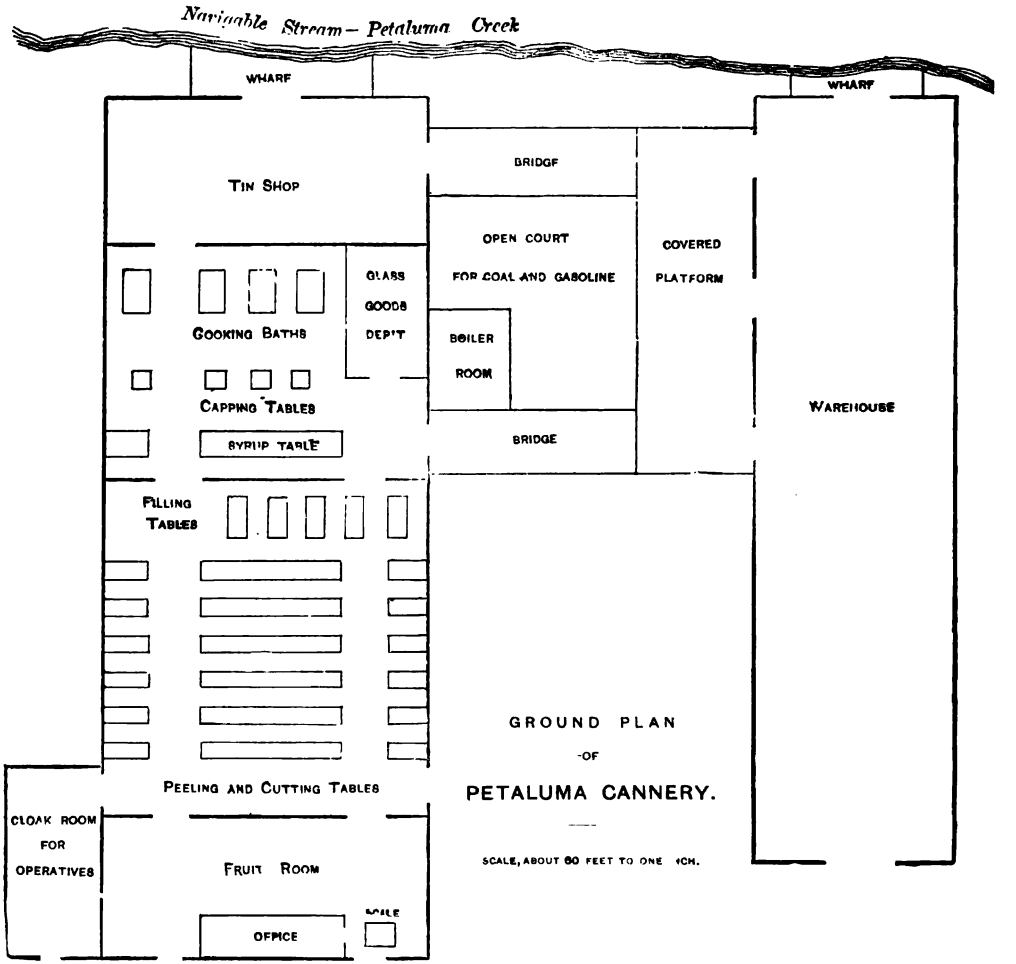
Fruit canning began in California about thirty-two years ago, but during the last decade has attained its greatness, and is now promising much wider extension. The process is simple, and yet is attended at every point, from the purchase of the fruit to the sale of the product, with operations which require experience, wisdom, and good judgment. It will be obviously impossible to give in print a guide to the pursuit of such an industry, and yet a few facts about some of the general features of the manufacture and the means employed will be of interest.

The principles involved in the process of commercial canning are of course the same as rule in the old kitchen processes, but to secure uniformity and cheapness of product a vast number of manipulations and appliances have been devised. The chief features of canning operations may be summarized as follows: First, preparation of the cans (which is done in the winter); second, preparation of the fruit; third, packing in the cans; fourth, introduction of the syrup; fifth, capping the cans; sixth, cooking the fruit; seventh, labeling and casing. Each of these operations is performed by a special class of operatives, and the closest division of labor is arranged. The success of the whole depends upon the experience and wisdom of the manager, who must be able to recognize at a glance when every operation is being rightly performed, and every material is in proper condition, and how processes must be varied to meet changed conditions in the material. It goes without saying that success depends not alone upon the interior operation of the establishment, but upon the purchase of suitable raw materials as cheaply as possible, for the business is transacted on narrow margins.

The progressive application of the various steps in the operation of canning and the appliances employed can be best illustrated by reference to the ground plan of one of our best and most conveniently arranged establishments, that of the Petaluma Cannery, situated on navigable water adjacent to the northern shores of the bay of San Francisco. Nearest to the highway are the fruit-room and office, where the fruit is received from the wagons, weighed, and credited. Opening from the highway also is the operatives' room, fitted with storage facilities for outer garments, lunch pails, etc., all of which are received and checked for by a clerk; for otherwise the commin-

*See page 367.

gling of the personal effects of several hundred operatives would result in indescribable confusion. From the fruit-room the fruit is passed over a long counter to the operatives of the peeling and cutting-room. It is handled by them by piecework, and



the work of each recognized by proper tickets. Thence the prepared fruit goes to the filling tables, where it is put in the cans, which are grouped in frames holding a dozen cans. These are carried to the syrup tables, where other operatives fill the cans

with syrup from pipes connecting with tanks to which syrups of different densities, according to the fruit which is being worked, or the grade of goods, is stored in bulk. The cans go next to the capping-tables, where the cover is put on and soldered, sometimes by hand, sometimes by soldering machines, the heat being secured with gasoline. A minute vent-hole is left in the cover of each can. The cans are then placed in large iron frames, or trays, holding, perhaps, a gross of them, and these are raised and swung around by cranes, and plunged in the cooking-baths, in which the water is kept boiling by means of steam from the boiler, which is generally situated outside the building. The amount of cooking varies with different fruits, and with the same fruit in different conditions. The cooking must be directed by the man in charge, and upon his experience and judgment depends largely the success of the whole work of the cannery. After the vent is closed, and the final touch of the cooking process given, the cans, after thorough cooling, are ready for labeling and casing.

Such is a mere outline of the process of commercial canning. The diagram of the Petaluma Cannery shows how buildings and appliances are arranged for the different parts of the process. The building is a high, one-story structure, with a trussed roof. There are no partitions in the cannery proper, and the manager can, by looking through the glazed side of the office, have the whole establishment under his eye, from the entrance of the fruit at the scales to its exit from the cooking-baths. Between the manufacturing rooms and the tin-shop there is a high partition. The Petaluma Cannery has also a department devoted to the putting up of extra fine goods in glass bottles, a feature which other canneries do not have. The establishment has a capacity of about one hundred thousand cases in a season, and room for the employment of about five hundred operatives. Its cost, including buildings and full outfit, is approximately $30,000.

THE OUTFIT OF A CANNERY.—Although all canneries have the same general kind of an outfit, there is much difference in size and cost. Some establishments were started on a very small scale, and have expanded as their business and capital warranted. Those interested in the subject generally ask for the items and cost of a moderate-sized outfit. Mr. J. J. Groom, of Los Gatos, who makes a specialty of fitting up canneries, furnishes the following estimate on the expense of building and plant:—

TOOLS, MACHINERY, AND BUILDINGS.

1 steam boiler, 48 in. by 16 ft.	$1,000
1 engine $250, 1 elevator $100	350
1 press $90, 2 comb dies $80, 2 cap dies $30	200
12 fire pots $120, 1 gasoline tank pump $125, etc.	245
4 seaming frames $10, 8 body seamers $20	30
4 sets truck wheels $25, 4 flat plates $6	31
1 square shears $44, 1 tin former $10	54
1 vice $9, 4 processing tanks $60	69
75 iron trays $70, 1 large scale $60	130
2 doz. small balance scales	36
6 doz. pitting knives $45, 2 capping machines $250	295
1 5,000-gallon water tank $65, 5 syrup tanks $40	105
Small tools, globe valve, piping, etc	200
Tables, benches, and boxes	150
12 doz. fruit knives $21, 1 anvil $10	31
Total	$2,926
Cannery building 50x100 ft., two story	$2,500
Warehouse 20x100 ft., one story	1,600
Total	$7,026

These buildings can all be built of rough lumber except the floors; they should be of the best material, say Oregon pine flooring, and laid to drain well. The buildings can be boarded up and down with battens.

Such an establishment will have a capacity for putting up half a million cans during the season.

ORCHARD CANNING.—This term is given to small establishments in which the grower puts up his own fruit for sale in cans or jars. There have been several devices patented by Californians during the last few years to enable the small canner to cook his fruit in the package, and a number of them are now in successful use, and there may ultimately be a large product of this class. The orchard canner has the advantage of securing his fruit in its best possible condition, right from the tree, but the requirements of personal attention and investment in labor, cans, and sugar, are considerable, and the grower generally prefers to relegate the manufacturing to a co-operative establishment, or a purchasing canner.

CRYSTALLIZED FRUITS.

There has been some progress made during the last few years in the production of candied, crystallized, or *glacé* fruits. Special establishments are now doing this work in Los Angeles, San Jose, and San Francisco. They have processes which are the result of considerable experimentation, and they do not make them public. To others the way lies open to similar experimentation. The United States consular reports give accounts of French practices* which will be found suggestive, but

*Republished in *Pacific Rural Press* January 22 and February 12, 1887.

exact processes for California fruits can only be learned by experience. The general theory and an outline of practice were recently given by J. J. Pratt, of the Yuba City Cannery, as follows:—

The theory is to extract the juice from the fruit, and replace it with sugar syrup, which, upon hardening, preserves the fruit from decay, and at the same time retains the natural shape of the fruit. All kinds of fruit are capable of being preserved under this process. Though the method is very simple, there is a certain skill required that is acquired only by practice. The several successive steps in the process are about as follows:—

First, the same care in selecting and grading the fruit should be taken as for canning; that is, the fruit should be all of one size, and as near the same ripeness as possible. The exact degree of ripeness is of great importance, which is at that stage when fruit is best for canning. Peaches, pears, etc., are pared and cut in halves, as for canning; plums, cherries, etc., are pitted. The fruit, having thus been carefully prepared, is put in a basket, or a bucket with a perforated bottom, and immersed in boiling water. The object of this is to dilute and extract the juice of the fruit. The length of time the fruit is immersed is the most important part of the process. If left too long, it is overcooked and becomes soft; if not immersed long enough, the juice is not sufficiently extracted, which prevents a perfect absorption of the sugar.

After the fruit has been thus scalded and allowed to cool, it can again be assorted as to softness. The next step is the syrup, which is made of white sugar and water. The softer the fruit the heavier the syrup required. Ordinarily about seventy degrees, Balling's saccharometer, is about the proper weight for the syrup.

The fruit is then placed in earthen pans, and covered with the syrup, where it is left to remain about a week. The sugar enters the fruit and displaces what juice remained after the scalding process.

The fruit now requires careful watching, as fermentation will soon take place, and when this has reached a certain stage, the fruit and syrup are heated to a boiling degree, which checks the fermentation. This heating process should be repeated as often as necessary for about six weeks.

The fruit is then taken out of the syrup, and washed in clean water, and it is then ready to be either *glacéd* or crystallized as the operator may wish. If *glacéd*, the fruit is dipped in thick sugar syrup and left to harden quickly in open air. If it is to be crystallized, dip in the same kind of syrup, but is made to cool and harden slowly, thus causing the sugar which covers the fruit to crystallize. The fruit is now ready for boxing and shipping. Fruit thus prepared will keep in any climate and stand transportation.*

Thus far the crystallized fruit produced in California has sold well. There is a considerable importation of French fruit to the United States, which may be displaced by the California product, and the business commends itself to those who have ingenuity, patience, and capital enough to enable them to experiment and wait for future success. The California producer has the advantage of an abundance of very fine fruit at a low price. According to the consular reports, the fruits best for crystallizing are not cheap in France.

FRUIT DRYING.

To describe minutely the methods and appliances employed for the drying of fruit in California would require a volume, and

*Prize Essay State Board Horticulture, 1888.

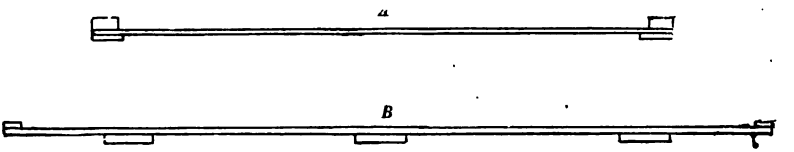
is beyond the scope of this treatise. Nearly all the patented evaporators which have gained prominence at the East have been introduced here, and we have a host of inventions of our own which are also employed. It will be impossible to discuss these machines or describe their uses. Good fruit has been made with all of them, and there are some who condemn them all. Very much depends upon personal skill and care in the use of fire in fruit drying. One contemplating the purchase of an artificial fruit drier should give some time to investigating the different machines. He should see them in operation and talk with those who are using them, and endeavor to form an opinion as to how much of success or failure which may be reported may be due the operator.

The use of machine driers is most prevalent in the coast valleys. As stated in Chapter I, regions subject to coast influences have a less duration and intensity of sun heat, and a more humid atmosphere than the interior, and are, therefore, less fitted for sun drying, though the sun is largely employed. Since it has been ascertained that, by the use of sulphur before exposing the fruit to the sun, it can be cured without darkening its color, sun drying has largely taken the place of machine drying. The capacity of any machine is infinitesimal as compared with the acreage of sunshine, and the proportion of sun-dried fruit over machine dried, during the last two years, has been vast. Owing to the beautiful light color of the fruit and the great care in boxing and adorning it, sun-dried fruit from the interior valleys and foot-hills of California has sold as evaporated fruit—than which a higher commercial tribute cannot be paid to its excellence. Though this is true, there is still a great field for machine driers. Their capacity and economical use of heat are continually being improved, and their product, when well manipulated, approaches perfection as a preserved product.

Although the sun drying of fruit may be a simple process, there have been so many little arts, methods, and appliances introduced to facilitate work or improve the product, that one can learn much by visiting the different fruit regions during the drying season. Such a course is commended to growers who contemplate large drying operations. The notes of practice which can be given in this connection must be brief and general.

TRAYS FOR DRYING.—The greater part of the fruit, including raisins, is placed upon trays for exposure to the sun. There is great variation in the size of the trays. The common small tray is made of one-half-inch sugar-pine lumber two feet wide and three feet long, the boards forming it being held together by nailing to a cleat on each end, one by one and a quar-

ter inches, and a lath or narrow piece of half-inch stuff is nailed over the ends of the boards, thus stiffening the tray and aiding to prevent warping. A cross-section of such a tray is shown at *A*. This is the standard tray, and was first used for raisin curing by the late G. G. Briggs.



CROSS SECTIONS OF DRYING TRAYS.

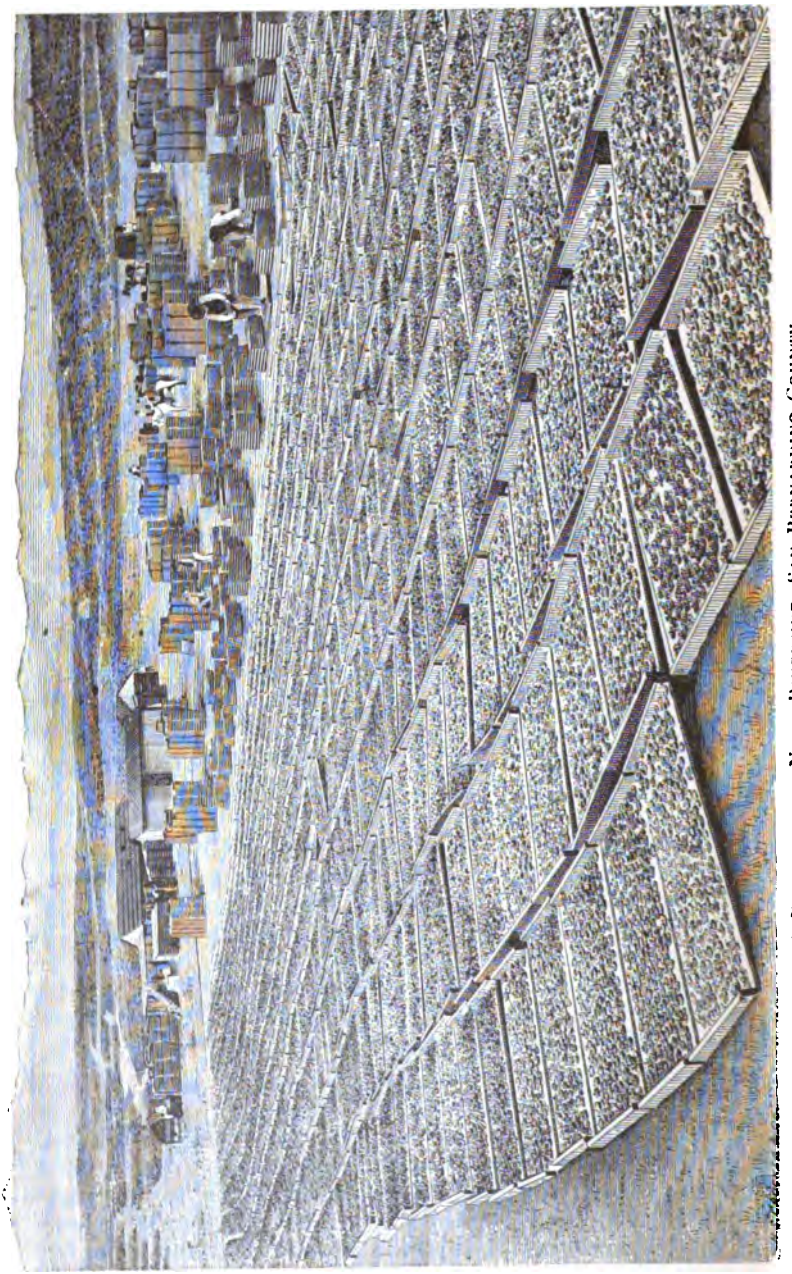
A large tray which is used by some growers is four feet square, and is made of slats three-eighths of an inch thick, and one and a half inches wide, the slats being nailed to three cross slats three-eighths of an inch thick and three inches wide, and the ends nailed to a narrow strip one-half inch thick by three-quarters of an inch wide on the other side. A cross section of this tray is shown at *B*.

Still larger trays are used, as large as three feet by eight, but these trays are usually moved from the cutting-house to the drying-ground on tram cars.

Another style of tray is made with a wooden frame over which heavy paper coated with linseed oil or paraffine paint to exclude juice or moisture, is drawn and tacked. Instead of trays fruit is sometimes spread on similar paper, which is bought in the roll. China matting is also used to some extent. These materials cost less than trays, but the latter are the more easily handled and more durable.

PROTECTING FRUIT FROM DEW.—In the interior there is seldom any deposit of dew in the drying season, but occasionally there are early rains before the drying season is over The fruit is then protected by piling the trays one upon another, in which operation the thick cleats serve a good purpose. In dewy regions the trays are piled at night, or cloth or paper is sometimes stretched over the fruit, thus reducing the discoloration resulting from deposits of moisture upon it.

DRYING FLOORS.—For the most part the trays are laid directly on the ground, but sometimes a staging of posts and rails is built to support them, about twenty inches from the ground. The drying trays are sometimes distributed through the orchard or vineyard, thus drying the fruit with as little carrying as possible. Others clear off a large space outside the plantation and spread the trays where full sunshine can be obtained. Drying



A Drying-floor Near Riverside, San Bernardino County.

spaces should be selected at a distance from traveled roads, to prevent the deposit of dust on the fruit.

CUTTING-SHEDS.—Shelter of some kind is always provided for the fruit-cutters. Sometimes it is only a temporary bower made of poles and beams upon which tree branches are spread as a thatch; sometimes open side-sheds with boarded roof, and sometimes a finished fruit-house is built, two stories high, the lower story opening with large doors on the north side, and with a large loft above, where the dried fruit can be sweated, packed, and stored for sale. The climate is such that almost any shelter which suits the taste and purse of the producer will answer the purpose.

SULPHURING.—There is constant discussion concerning the desirability of sulphur fumes in connection with fruit drying. The discussion may result in educating buyers so that they will purchase unsulphured fruit at a good price, but they are of no such mind at present, and the producer cannot afford to do otherwise than use sulphur on fruits on which the demand is for a light color. Sulphur-bleaching of old, discolored, sun-dried fruit in a sort of resurrecting process, is very different from the exposure of freshly-cut fruit to sulphur fumes before putting out in the sunshine. The latter is the practice which is at present usually signified by the term sulphuring, although sulphur is also used with the machine driers.

There are various contrivances for the application of sulphur fumes to the freshly-cut fruit. Some are small for hand carriage of trays; some are large and the trays are wheeled into them upon trucks. The most common is a bottomless cabinet about five or six feet high, of a width equal to the length of the tray and a depth a little more than the width of the tray. The cabinet has a door the whole width of one side, and on the sides within cleats are nailed so that the trays of fruit slip in like drawers into a bureau. Some push in the trays so that the bottom one leaves a little space at the back, the next a little space at the front, and so on, that the fumes may be forced by the draft to pass between the trays back and forward. The essentials seem to be to open holes or dampers in the bottom and top of the cabinet so that the fumes from the sulphur burning at the bottom may be thoroughly distributed through the interior, and then all openings are tightly closed. To secure a tight chamber the door has its edges felted and the cabinet is made of matched lumber. The sulphur is usually put on a shovel or iron pot, and it is ignited by a hot coal, or a hot iron, or it is thrown on paper of which the edges are set on fire, or a little al-

cohol is put on the sulphur and lighted, etc. The sulphur is usually burned in a pit in the ground under the cabinet, though some advise having the sulphur burned in a little furnace outside, the fumes being drawn into the cabinet through the pipe from the stove. Some use strips of cloth dipped in melted sulphur and cooled. These strips can be torn off at any desired length, lighted, and put under the trays. The application of sulphur must be watchfully and carefully made, and the exposure of the fruit should only be long enough to accomplish the end desired. The exposure required differs with different fruits, and with the same fruits in different conditions, as must be learned by experience. Apples require least exposure to sulphur; apricots and peaches will stand more. Probably the prevailing time of exposure is thirty to sixty minutes. Some growers claim that shorter time will answer, but present practice is as stated.

GRADING AND CLEANING.—After the fruit is sufficiently dried, and it is impossible to describe how this point may be recognized except by the experienced touch, it is gathered from the trays into large boxes and taken to the fruit-house. Some growers put it into a revolving drum of punctured sheet iron, which rubs the pieces together and separates it from dust, etc., which falls out through the apertures as the drum revolves. Others empty the boxes upon a large wire-cloth table and pick it over, grading it according to size and color, and at the same time the dust and small particles of foreign matter fall through the wire cloth.

SWEATING.—All fruit, if stored in mass after drying, becomes moist. This action should take place before packing. To facilitate it, the fruit is put in piles on the floor of the fruit-house and turned occasionally with a scoop shovel; or, if allowed to sweat in boxes, the fruit is occasionally poured from one box to another. The sweating equalizes the moisture throughout the mass. Some large producers have sweat-rooms with tight walls, which preserve an even temperature. No fruit should be packed before "going through the sweat." If this is not done, discoloration and injury will result.

DIPPING BEFORE PACKING.—Some producers put the fruit in wire baskets and dip in boiling water before packing. Much objection is made to the practice, because some producers have, apparently through avarice to secure great weight, packed too much water with the fruit, and have thus absolutely ruined it. Like many other practices, it must be wisely and intelligently done or it had better be abandoned. To dip in boiling water to

kill eggs of vermin, and to make the fruit a little more pliable for the press, has been a common practice for several years. The dipping should be done quickly, and the fruit allowed to drain. It should not be allowed to soak in the water. The tendency with sun-drying is to get the fruit too dry. Dipping and then allowing the fruit to lie in a dark room carefully covered for twenty-four hours before packing has been the method. Still it would no doubt be better if the fruit should be taken up just exactly in the right stage of dryness, and then exposed to high heat in a close chamber for a few moments to kill insect eggs, instead of dipping. But dipping has fallen into disrepute, and some who have packed the fruit without dipping or heating, report good results.

PACKING.—To open well, packages of dried fruit should be "faced." The many fine arts of paper lining, etc., must be learned by observation. Flatten some fair specimens of the fruit to be packed (and reference is especially made to such fruits as apricots, peaches, and nectarines) by running them through a clothes' wringer or similar pair of rollers. Do not face with better fruit than the package is to contain. It is a fraud which will not in the end be profitable. Lay the flattened fruit (cup-side down) neatly in the bottom of the box. Fill in the box until it reaches the amount the box is to contain, and then apply the press until the bottom can be nailed on. Invert the box and put on the label or brand; the bottom then becomes the top.

Many different kinds of boxes are used. A very good size is made of seasoned pine, six inches deep by nine inches wide by fifteen inches long, inside measurements, and it will hold twenty-five pounds of fruit.

Recently there is preference for fruit in cotton sacks, and much is marketed in that way, but some producers insist on boxing their fruit for gain in weight, by preventing drying out, and the better chance of establishing a reputation for their brands. The producer, as a rule, will adopt whatever style of packing will give him the best results, and he will have to rely largely on experience to teach him that.

METHODS WITH DIFFERENT FRUITS.

As already intimated, it will be impossible to enter minutely into the operations of drying and packing on a commercial scale, or even to notice all the small and ingenious arts by which the work is facilitated. As has been suggested concerning the working of machine driers, anyone who contemplates production on a large scale should personally visit leading regions and inform

GATHERING APRICOTS FOR DRYING IN DR. JARVIS' ORCHARD, RIVERSIDE.

himself by inquiry and observation. Such an education will save mistakes, which may cost many times more than the expense of getting it. California producers are usually quite willing to show visitors the methods they employ. Though this is the better way of proceeding, a few general hints will be given of methods with different fruits.

APPLES.—There seems little use of drying apples unless a very light-colored, handsome product can be turned out. This can be done by sulphuring as soon as cut, and sun drying in a dry region, or by the use of a machine evaporator in regions of greater atmospheric humidity.

APRICOTS.—Apricots for drying should be fully ripe but not soft enough to be mushy. By the use of sulphur and sun heat, or the machine, an amber-colored, semi-translucent fruit is obtained, which sells at excellent prices. Pick the fruit without bruising, and haul to the cutting-shed in spring trucks. Some shake apricots upon sheets, but the best product is hand-picked. Pit the fruit by a clean cut completely around in the suture; do not cut part way round and then tear apart—a clean-cut edge is essential. Put on the trays with the skin down, or with the cup up, as it is sometimes described; sulphur, and then put in the sun. About three days of interior-valley sunshine will finish the apricots. Apricots will yield on the average one pound of dried fruit to five pounds of fresh.

BERRIES AND CHERRIES.—These fruits are only dried in the sun in small quantities for local sale, and ordinary farm-house methods are employed.

FIGS.—The "second crop" of the fig is usually employed for drying, as stated on page 413. The fruit may be carefully picked from the tree so as to secure the whole of the stem, when the fruit is fully ripe, as is known by the seaming or slight shriveling of the skin. In drying the common black fig from large trees, however, the fruit is generally gathered from the ground, which is cleaned and smoothed before the crop ripens. In drying black figs the fruit is placed on trays and in most cases exposed to the sun, but some foot-hill growers maintain the advantage of drying in the shade. The figs should not be allowed to dry hard. When sufficiently cured, put in sweat-boxes for several days, and when ready to pack dip in boiling salt water, or, as is the practice of some producers, dip in boiling syrup. In either method a good, pliable condition and handsome color are obtained. In drying white figs many sulphur the fruit from fifteen minutes to an hour before putting out on the trays. Figs which dry slowly have to be turned several times

during the drying, and those which are apt to run juice are placed so that the eye is raised a little until the juice is thickened. The white figs are also put in sweat-boxes and dipped in hot salt water before packing. In packing, the figs are often flattened and drawn out by the hand. Such manipulation gives the fig a lighter and more translucent appearance. The time required in drying figs is usually from five to eight or ten days, according to location and weather. The fruit does not cure evenly, and those which are finished (as determined by sight and touch—to be learned by experience) are picked from the trays, and the others given more time.

PEARS.—The dried pear product is small, and, as with apples, only a light-colored product is profitable. These are made by sulphuring and sun drying, or by the use of the machine drier.

PEACHES.—Peaches are sun dried in much the same way as apricots, already described. Take the fruit when it is fully ripe, but not mushy; cut cleanly all around to extract the pit and put on trays cup-side up; get into the sulphur box as soon as possible after cutting. Peaches are dried both peeled and unpeeled, and, just at present, drying without peeling is prevalent. Peeling is done with the small paring-machines, or with a knife, and in some cases with lye, but lye peeling has been generally abandoned because of discoloration of the fruit after packing.

To use lye in peeling requires a vast amount of fresh water for rinsing—in fact, running water seems necessary to prevent the accumulation of the alkali in the rinsing water. In the strength of the lye there is difference in the practice of different producers, but from one-half to one pound to the gallon of water covers both extremes. The lye is kept boiling, the fruit is put in galvanized wire baskets and plunged in for a few seconds. The speed of the operation depends upon heat and the strength of the lye; the dipper tests the efficacy by touching the skin of the peach with a small stick, and if it rubs off easily, the fruit is plunged in the rinsing bath and stirred around until the peaches are clear of the skin. It is then plunged in a fresh bath and kept in water until required by the cutters.

Clingstone peaches are cut with a knife invented by G. W. Tarlton, of San Jose. It consists of the blade of any common knife (like a shoe-knife), with a short U-shaped blade set in at the point of the main blade. In cutting the peach in halves, the curved blade skims around the stone, completely severing it from the peach. This device has enabled the grower to pit clings as easily as freestones, but, owing to the strength required in the wrist, the pitting of clings can best be done by men. The

Tarlton knife works admirably, both with mellow and quite firm fruit, and is, therefore, vastly superior to the spoon-shaped knife, which can only be used on soft fruit. A strong, active man can pit five hundred to seven hundred pounds of clings in a day.

THE TARLTON KNIFE FOR PITTING CLINGSTONE PEACHES.

The weight of dried peaches which can be obtained from a certain weight of fresh fruit, depends upon the variety; some varieties yield at least a third more than others, and clings yield more than freestones as a rule. Dry-fleshed peaches, like the Muir, yield one pound dry from four or five pounds fresh, while other more juicy fruit may require six or seven pounds.

NECTARINES.—Nectarines are handled like peaches; the production of translucent amber fruit in the sun depends upon the skillful use of sulphur.

PLUMS AND PRUNES.—Our pitted plums, which are an acid fruit, seem to meet a small demand, though for the last year or two the product is meeting with more favor. Pitting is done by hand or by the use of foot-power "pitters." More rapid and capacious machines are being brought out by inventors, and a large product could be easily turned out if prices would warrant.

Prunes, on the other hand, are one of our greatest and most promising products. Several varieties which dry sweet with the pit in are used in making prunes, as already stated in Chapter XXII, but the prevailing variety is the Prune d' Agen.

Prunes are gathered by shaking from the trees, usually upon sheets spread beneath. A local invention which is giving satisfaction is that of George A. Fleming, of San Jose, for which a patent has been obtained. It is a simple machine, consisting merely of a very low platform wagon with a sideboard on one side. Boxes are arranged on the platform, and to one side is hinged a slatted frame (in two sections), and to the outer edge of this two canvas sheets, each eight by sixteen feet, are attached by their short sides. The wagon (or sled) is drawn by one horse, and when opposite a tree the hinged frames of slats are turned down and two men, one for each sheet, spread them under, one each side of the trunk of a tree, and, standing on the outer edges of the cloths, gently shake the tree. When all the prunes ripe enough have fallen, the two men gather up the sheets, commencing at the outer extremity, the fruit rolls along upon the hinged frame, the leaves, twigs, and dust fall through the openings, and, raising the frame, the fruit rolls off into the

boxes on the platform of the truck. This arrangement is found to be a great saver of labor.

Prunes are usually graded before drying, and various home-made contrivances are employed. Some use inclined planes of adjustable slats, the grader being thus available for other fruits than prunes; the large fruit rolls along into receptacles at the bottom, while the small fruit falls through into other receptacles. Other grading devices are made with wire screens or riddles of different sizes of mesh. Some of them work on the principle of a fanning mill, three to four riddles, placed above one another, each with a slight incline, and a spout on the side where each grade drops in a box. Some have a long riddle, say twelve feet long, with three different sizes of wire screen on it. This riddle is hung upon four ropes with an incline; the prunes are thrown in the higher end, and by shaking it they roll down and fall through the holes into boxes underneath. The first piece of screen should be small, to let only stems and dirt through, and no prunes. This long hanging screen is also used to grade prunes after drying. There are now several excellent manufactured fruit graders on sale in this State. Their work is very satisfactory and they have largely displaced home-made contrivances.

The next step in the process is dipping in lye to thin and crack the skin, which facilitates the escape of moisture in the drying process. In a large caldron lye is made with one pound of concentrated lye to each twenty gallons of water, and kept boiling hot. The fruit is put into wire baskets or galvanized pails with perforated sides and bottoms, and dipped in the boiling lye for about a minute, or until the skin has a wrinkled appearance, then plunge the basket into clean cold water to rinse off the lye. This rinsing water must be frequently changed, for it soon becomes very alkaline. After this dipping, the prunes are placed on trays ready for the machine-drier, or for the sunshine. In the sun the prune dries sufficiently in from one to two weeks, according to the situation and weather.

When sufficiently dried, the prunes are put through the "sweat," which takes from several days to two or three weeks, and then are ready for grading, finishing, and packing. In grading, the prunes are separated by the use of a grader, as already described, into a number of grades, the largest, forty prunes to the pound, and so on, fifty, sixty, etc., to the smallest, which may run one hundred to the pound. Finishing consists in exposing to steam, in dipping in clear hot water, or hot sugar syrup, or in dipping in boiled juice of ripe prunes, or peaches or apples, etc. Although there is a great variety of materials used for "glossing" prunes by different producers, the prevailing practice is to

rely upon hot water, to which pure glycerine is added at the rate of one pound to twenty gallons. Some growers also add a little brine (having first dissolved the salt and skimmed off the impurities). This final hot dip kills insect eggs, and the fruit, after drying off away from the access of insects, should be packed tightly in boxes or cannisters.

Recently some makers are processing prunes by steam heat at a high degree, which darkens the color and gives the prunes the cooked flavor which is characteristic of the French prune. A darker hue may also be given to the prune by using a little extract of logwood in the final dip, but this practice is not largely adopted. The lighter color of the California prune is proving useful as a distinguishing mark, now that the excellence of the fruit is widely recognized.

RAISINS.—The varieties of grapes used for raisins are described on pages 398 and 399. The production of raisins has reached such an extent, and employs so many ingenious persons, that the processes employed to facilitate the curing and packing are so various that a description of them cannot be attempted. Besides, there is now available an excellent special treatise on this subject.* However, in beginning the commercial production of raisins, one should visit the raisin farms and packing-houses during the harvest. The following description gives an outline of the latest practice, and is from the pen of a prominent producer of the Fresno district:†

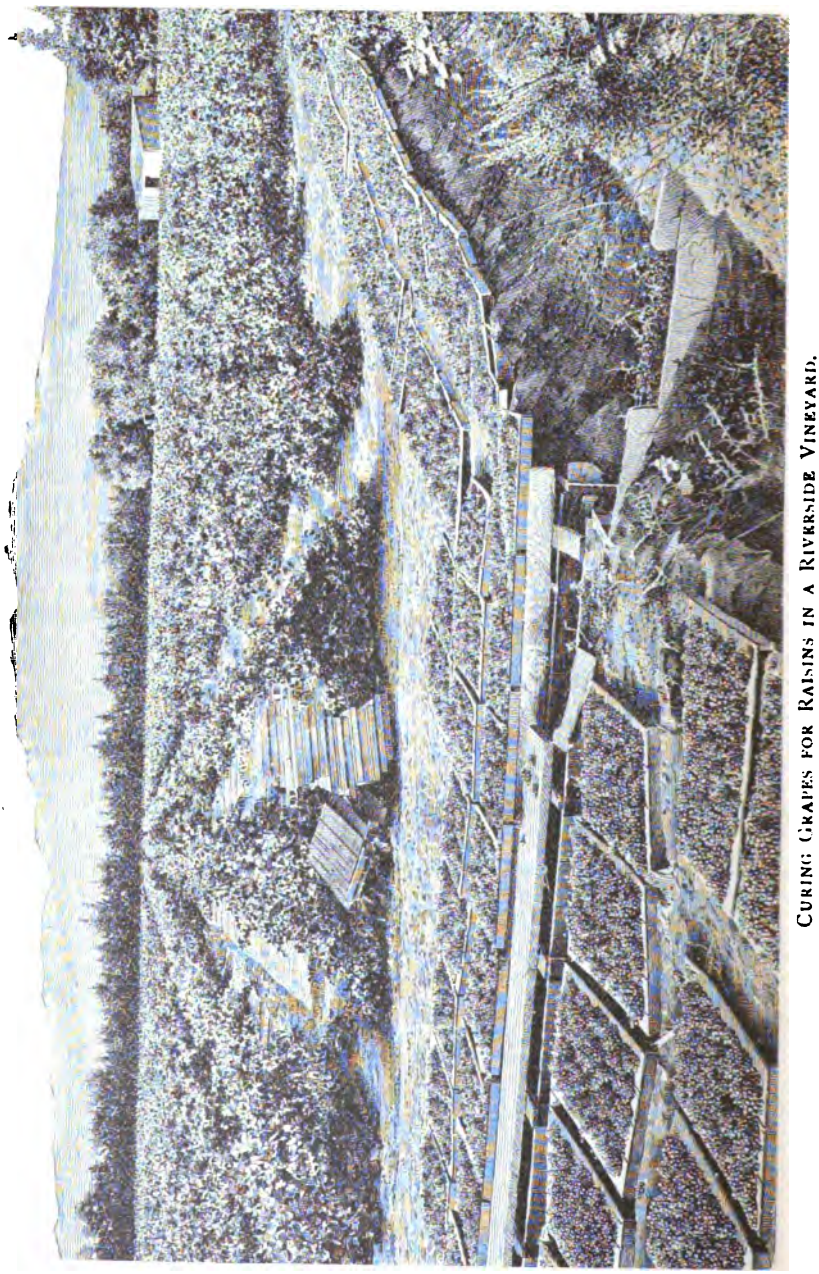
In Fresno picking commences about the 1st of September, although there have been seasons when it occurred as early as the 20th of August. The grapes under no circumstances should be picked for raisins until they are ripe. There are three ways by which to ascertain this fact: First, by the color, which should be a light amber; second, by the taste; and third, by the saccharometer, which is by far the most accurate. A grape may be ripe and not have the proper color, when grown entirely in the shade. The juice of the grape should contain at least twenty-five per cent sacchararine, to produce a good raisin.

The most practicable method of drying is by the use of trays placed upon the ground. The almost entire absence of dew in our locality greatly facilitates this method. The trays are usually twenty-four by thirty-six inches. Those of larger dimensions are found inconvenient to handle when filled. Trays of the former size hold about twenty pounds of fruit, and should produce from six to seven pounds of raisins. The product of a vineyard depends largely upon its age and favorable conditions, varying from two to nine tons of grapes per acre.

The trays, or platforms, are taken into the field and distributed along the sides of the roads, from which they are taken by the pickers as they are needed. As the grapes are picked from the vines, all imperfect berries, sticks, and dead leaves are removed from the bunches, which are then placed upon the trays, right side up. A cluster has what is called a right and a wrong side, the wrong side having more of the stems exposed than the right side. Great care should be used in picking, so as to handle the bunches only by the stem. If the berries come in contact with the

* "The Raisin Industry," by Dr. Gustav Eisen, large 8vo, 255 pp., fully illustrated. H. S. Crocker & Co., San Francisco. This standard work should be included in the list of works on the grape industry to be found on page 367.

†Address of T. C. White, at Viticultural Convention of 1888.



CURING GRAPES FOR RAISINS IN A RIVERSIDE VINEYARD.

hands, some of the bloom will be removed, which will injure the appearance of the raisin. The trays are placed, after filling, between the vines, one end being elevated so that the grapes may receive the more direct rays of the sun.

The length of time required for drying depends much upon location and conditions, favorable or otherwise. I have known raisins to be dried in seven days, but they were not a good article, and too rapid drying is not desirable. The grapes are left upon the trays until about two-thirds dry, which, with us, will be in from six to eight days. They are then turned. This is accomplished by placing an empty tray on top of the one filled with partially-dried raisins, and turning them both over. Then take off the upper or original tray, and you have the raisins turned without handling or damage. After turning, curing will proceed more rapidly, and frequently is completed in four or five days. During this time they should be carefully watched to prevent any from becoming too dry. When it is found they are dry enough, the trays are gathered and stacked one upon another as high as convenient for the sorting, which follows. This protects them from the sun and prevents overdrying. Stacking should be attended to early in the morning, while the stems and berries are slightly moist and cool from the night air, as they will retain this moisture after being transferred to the sweat-boxes, and assist in quickening the sweating process.

As the raisins are taken off the trays, some of the berries on the bunches will be dry enough and a few will not be sufficiently cured. To remove the moist ones would destroy the appearance of the cluster, and to leave it out longer would shrivel the dry ones, hence the sweat-box. The moisture is diffused through the box, some being absorbed by the dry raisins, and the stems also taking their share are thus rendered tough and pliable and easily manipulated when ready for packing.

Sorting and grading require care and judgment, and although a tedious process, it greatly facilitates rapid packing. The sweat-box is a little larger than the tray and about eight inches deep, and contains about one hundred and twenty-five pounds of raisins. Heavy manilla paper is used in the sweat-boxes, one sheet being placed in the bottom, and three or four more at equal distances as the filling progresses. The object of the paper is to prevent the tangling of the stems and consequent breaking of the bunches when removed for packing.

The sorters have three sweat-boxes, one for the first, second, and third qualities, as the grade will justify. The bunches should be handled by the stem and placed carefully in the sweat-boxes to avoid breaking the stems, thereby destroying the symmetry of the clusters. Any found to be too damp are returned to the trays and left a day or two longer in the sun. To ascertain if the fruit is perfectly cured, take a raisin between the thumb and forefinger and roll it gently until softened, when either jelly or water will exude from the stem end—if water, it requires further drying. When the boxes are filled, they are taken to the equalizer. This should be built of brick or adobe, and as near air-tight as possible, but provided with windows to allow ventilation when necessary. The windows should have shutters to keep it dark. The filled boxes are placed one exactly upon another to a convenient height, and should remain from ten to twenty days or more, when they will have passed through the sweating process. When the raisins are sufficiently equalized, the sweat-boxes are removed to the packing-room, which is provided with tables, presses, scales, etc.

The most convenient mode of packing is that devised by Mr. Blowers, and consists in the use of a metal tray corresponding in size to a layer of raisins and having a loose bottom. The raisins are placed in the preliminary packing-tray with the face of the cluster downward, which gives the surface a level appearance and prevents the exposure of the stems. When the bottom of the packing-tray has been covered, which should always be with perfectly-shaped berries and bunches, the tray is filled to the requisite weight of five pounds. The contents of the tray are then pressed sufficiently to pack the raisins firmly together, but not with such force as to break the skin, causing the jelly to exude and consequent early sugaring. After being pressed they are transferred to the boxes, during which process the paper is wrapped around each layer. The paper is placed on the top of the tray of raisins, and a sheet of steel, the exact width of the trays, is placed above the paper, and the whole reversed. The sheet of steel serves to hold the raisins in place until the layer is put into the box, when the steel is withdrawn and the layer drops into the box face up. The standard box of California raisins is twenty pounds' weight, containing four layers of five

pounds each. They are usually graded into Dehesia and London layers, and one, two, and three crown loose Muscatels.

The foregoing relates to the preparation of the standard raisin as produced in California. Loose raisins are also produced in considerable quantities, and are faced beautifully by means of an invention patented by T. C. White, which consists of a flat, metal mould, or plate having depressions made in its surface, which plate forms the bottom of the preliminary packing-box, and serves to hold the raisins in a fixed position until the packing is completed and the raisins are placed in the box. Loose Muscatels are prepared by being put through the stemmer and grader. The stemmer removes the berries from the stems, and the grader, by separating according to size, determines the grade.

A considerable quantity of dipped raisins are also made of the Sultana grape and of loose or inferior Muscatels. A lye dip of about one pound of potash to three gallons of water is used, and the solution is kept boiling hot. The ripe fruit is dipped for an instant, then plunged in fresh water for a thorough rinsing, and then placed on the trays. During warm, dry weather in the interior, the raisins are dried in the shade by leaving the trays in piles, but if cooler, moister weather prevails, the trays must be spread out. The product is a handsome amber color.

Drying of wine grapes for sale at the East or in Europe is now practiced quite largely because of the present surplus wine product. It seems probable that quite an extensive demand can be found for the dried grapes, as they can be profitably produced at quite a low price.

GRAPE SYRUP.

The manufacture of grape syrup is coming into considerable prominence as a means of disposing of wine grapes, the price of which is sometimes unprofitably low. At the Malters vineyard an open evaporating pan of copper is used, and the product is about forty gallons of syrup per ton of grapes. Mr. Snavely, of the Woodland winery, crushed in 1890 from seven hundred to eight hundred tons of grapes, all of which were made into syrup, running evaporators night and day to attain an output of twenty thousand gallons. He thinks the Zinfandel and Seedless Sultanas the most profitable syrup grapes. They carry from twenty-four to twenty-six per cent saccharine. Grape syrup used to sell for sixty-five cents a gallon, but has been recently quoted at from thirty-five to forty cents, on account of increased production. At the Yolo winery, Mr. N. Wyckoff reduces the juice to syrup by steam heat, using his brandy still for the purpose.

PART NINTH: FRUIT PROTECTION.

INTRODUCTORY NOTE.

EXCEPTING the ill effects of severe winters, fruit-bearing trees and plants are subject to many evil influences and agencies, which vex the growers in other parts of the world. The free introduction of nursery stock, fruits, and seeds, has brought in many of the most destructive foreign insects and fungi, and others native to the territory have learned to forsake forest growths and live upon cultivated trees and plants. Some of the native species of the *rodentia* also relish the succulent food to be found in orchard and vineyard, and some birds, both native and introduced, sometimes work havoc both upon bud and fruit. Besides these animate invaders there is also need, in many cases, of protection against unfavorable natural phenomena, such as prevailing or occasional winds and frosts. It will be the aim of this Part Ninth to give outlines of methods which have been found measurably successful in protecting orchard, vineyard, and plantation from evils which, for convenience, will be arbitrarily classified as follows: (1) Repression of injurious insects; (2) repression of marauding animals and birds, or protection from their attacks; (3) protection against winds and frosts.

CHAPTER XXXVII.

INJURIOUS INSECTS.

DURING the early years of California fruit growing, the freedom of the fruit from burrowing worms and all uncleanness, was a well-founded claim, but the day of such immunity has passed away. Though we have thus far escaped some grievous pests, as, for example, the curculio of the plum, as stated in Chapter XXXII, we have acquired enough evil insects to keep our fruit growers busy in their repression. The climate which so favors tree and plant by a long, mild, growing season, also enables some insects to multiply much more rapidly than they do in wintry climes, some having several distinct broods, others carry-

ing on the work of reproduction and destruction of plants nearly the year round. If, however, as now seems likely, a good part of the repression of injurious insects may be trusted to other insects, parasitic or predatory, the climate will favor the multiplication of friend as well as foe, and thus carry its own compensation.

In order to arrange injurious insects in classes in a popular way, the grouping will be based upon the character of the work they do, an arrangement which has been followed by other writers, and which is better than attempting to group the insects which prey upon any single tree or plant, because injurious insects seldom restrict themselves to a single food plant. Therefore the grouping will be as follows: (1) Insects destroying foliage; (2) insects upon the bark or upon the surface of leaf and fruit; (3) insects boring into the twig, stem, or root; (4) insects boring into the pulp of fruits.

The literature upon the subject of insect pests in California is quite extensive, but much of it is beyond the reach of the general reader. There are, however, a number of publications which should be on the shelves of every fruit grower, and these will be cited.* The study of the pests and the invention of means for their destruction are, however, continually progressing, and one can only keep himself informed of this progress, and profit by improvements, by diligent reading of periodicals devoted to practical horticulture.

INSECTS DESTROYING FOLIAGE.

ARMY WORMS.—Smooth caterpillars about an inch or more in length when fully grown; prevailing color black, with light-colored stripes on the sides; moving forward in large bodies, hence the name; six forward legs; eight central legs; two rear legs; usually most destructive to grass and grain, but invade vineyards and orchards. Most available remedy is spraying the leaves with Paris green, one pound to two hundred gallons of water on most growth but not stronger than one pound to two hundred and fifty gallons on peach trees.

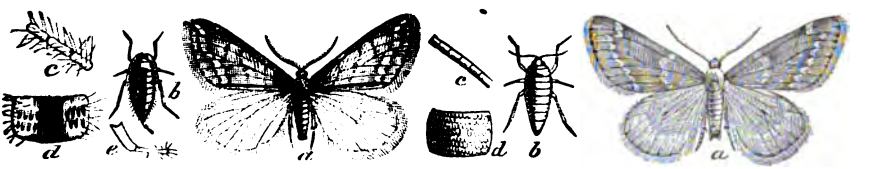
CUT WORMS.—Smooth, plump, dull-colored caterpillars destroying buds and leaves at night and hiding by day in loose dirt at the base of the plant. Remedy, Paris green as above, or uncover and kill the worms with a hoe.

* "Injurious Insects of the Orchard, Vineyard, etc," by Matthew Cooke; 8vo, 472 pages, fully illustrated. (Out of print.)

Reports and Bulletins California State University, College of Agriculture. Berkeley, Cal.; Reports State Board of Horticulture, 220 Sutter Street, S. F.; Reports State Viticultural Commissioners, 317 Pine Street, S. F. Published by the State.

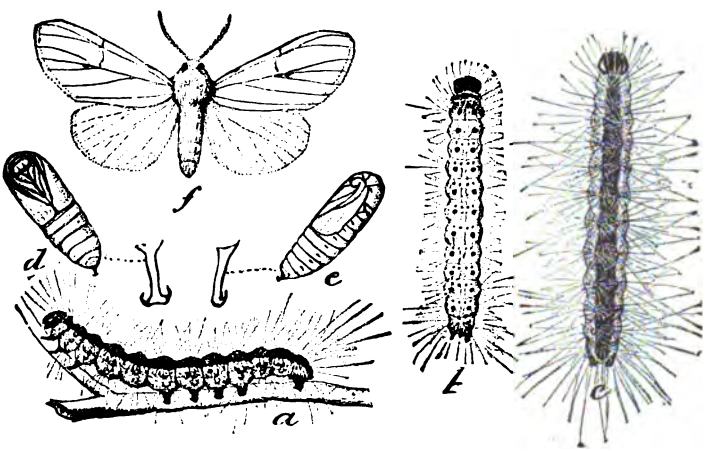
Reports United States Department of Agriculture, especially from 1880 to date, and special publications "Division of Entomology," Washington, D. C., published by the general government.

CANKER WORMS.—Slim caterpillars of different colors, moving by a looping gait, and often completely defoliating trees very early in the season. Remedy: Paris green spray, and banding of the trees with paper on which is spread a mixture of printers' ink and molasses, to prevent the wingless moth from ascending the trees to deposit eggs on the twigs. In this mild climate these bands must be put on in December and maintained through the winter.



CANKER-WORM MOTHS, TWO SPECIES.

TENT CATERPILLARS.—Several species of hairy caterpillars called "tent caterpillars," or "web-worms," from their spinning covers of cobweb-like material, under which they take shelter in large colonies; but one, at least, of the group does not



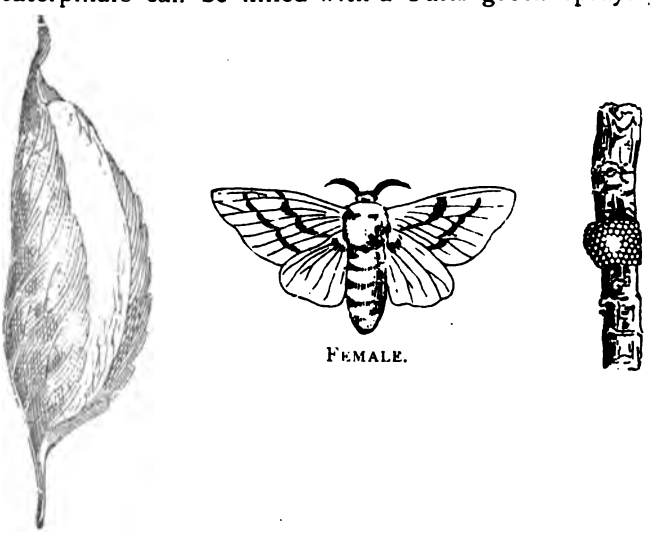
LARVÆ, PUPÆ, AND MOTH OF WEB-WORM.

spin a web, though it lives in clusters on the tree. The worms can be killed by burning the colonies with a torch on the end of a pole or by spraying the foliage with Paris green. The pest can be reduced by carefully collecting and burning the egg clusters while pruning. The egg cluster encircles the twig, as shown in the engraving on the next page.

RED-HUMPED CATERPILLAR.—Striped caterpillars, not hairy, but having two rows of black spines along the back, also living in clusters; of reddish color with yellow and white lines; a short distance back of the red head of the caterpillar is a red hump on which are four black spines; black spines are also scattered over the body, but smaller than those on the back. Spray with Paris green, or cut off and burn colonies.

RED-HUMPED CATERPILLAR AND MOTH.

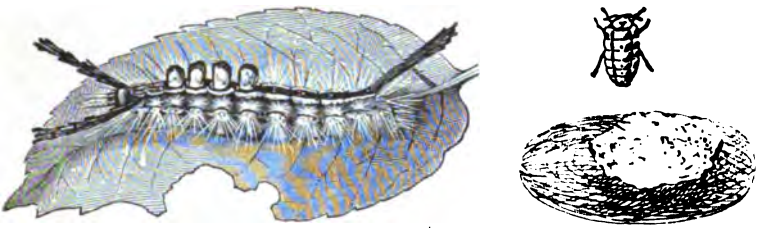
CATERPILLAR OF TUSSOCK MOTH.—A conspicuous caterpillar with four short, brush-like tufts on its back, and two long, black plumes at the front, and one at the rear of the body—see engraving. This leaf-eater is found on apple, pear, plum, and sometimes on other fruit trees, also on the walnut and oak. The caterpillars can be killed with a Paris green spray. The



FEMALE.

COCOON, MOTH AND EGGS OF TENT CATERPILLAR.

larva spins a cocoon in the fold of a leaf, and the female, after emerging from it, deposits her eggs upon the outside of the cocoon. The engraving on the next page shows the wingless moth and cocoon with the mass of eggs deposited upon it.



TUSSOCK MOTH LARVA, WINGLESS FEMALE, AND COCOON WITH EGGS.

PEAR AND CHERRY SLUG.—A small, slimy, dark-colored worm, with the fore part of the body notably larger than the rear part, eating the upper surface of the leaves but usually not making holes through them. The insect can be checked by throwing fine road dust or air-slaked lime over the tree, which cakes upon the slime of the worm and destroys it. On a large scale a Paris green spray is best.

THE PEAR AND CHERRY SLUG.

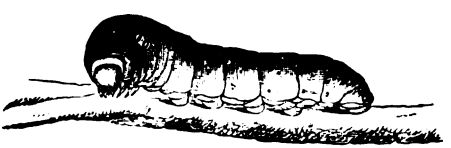
LARVÆ OF SAW-FLY ON PEAR LEAVES.

SAW-FLY WORMS.—There are several larvæ of saw-flies which do much injury to pear trees, currants, etc., by eating the whole leaf substance except the larger ribs. The worms are small, the one infesting the pear being about half an inch when fully grown. Its general appearance and work are shown by the engraving. The most available remedy is a Paris green spray.

LARGE CATERPILLARS ON GRAPE-VINES.—The grape-vine is often seriously injured by the attacks of very large leaf-eating

SPHINX MOTH LARVA ON GRAPE-VINES.

worms two inches and upwards in length, sometimes with a large horn, or spine, sometimes without. They are larvæ of several species of Sphinx moths or humming-bird moths, and of swallow-tail butterflies (*papilio*). The worms can be killed by Paris green spray or by hand-picking. The numbers of worms can be reduced by killing the large moths, which are abundant at nightfall on beds of verbenas, or other garden flowers. These worms are related to other large caterpillars, which feed on tobacco, tomatoes, etc.



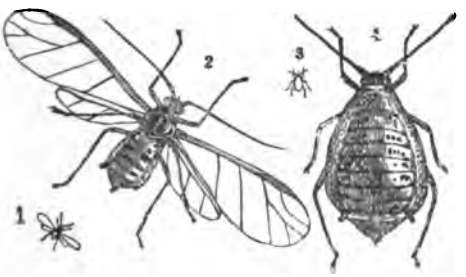
CATERPILLAR OF SWALLOW TAIL BUTTERFLY.

LEAF-EATING BEETLES.—There are many beetles, large and small, which infest grape leaves. They can all be reduced by the use of Paris green.

INSECTS UPON BARK OR SURFACE OF LEAVES OR FRUIT.

LEAF LICE.—Leaves of fruit trees, especially the apple and plum, are sometimes almost covered with lice or aphides of different colors, from light green to black, some individuals having wings and some wingless. An available remedy for all these leaf lice is a resin wash: Take one pound concentrated lye, four pounds resin. Dissolve the lye in two quarts of water. Add the resin; heat until dissolved and add two and a half gallons of water. Use one quart of the solution to the gallon of water. Use at a tempera-

ture of one hundred degrees Fahr., with a spray nozzle which sends spray upwards, so as to reach the under sides of the leaves. Very often these pests are effectually cleared out by lady-birds and other insects which devour them. The engraving shows the general form of the aphis tribe.



THE APHIS OR LEAF LOUSE.

THRIPS.—Very minute insects infesting leaves of pear, causing them to wither and fall off—the leaves usually being covered with black dots. Remedy, the resin wash as for leaf lice.

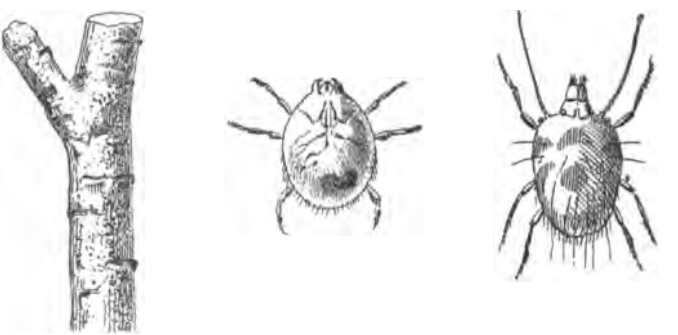
VINE HOPPERS.—Very minute, yellowish, jumping insects infesting grape-vines very early in the season, and multiplying rapidly. They exhaust the sap from the leaves, causing them to turn yellow and fall, exposing the grapes to sunburn. The insects are destroyed by making a frame of wire gauze, smeared on the inside with crude petroleum mixed with kerosene. This screen is placed over the vine, and the insects, which leap as soon as disturbed, come in contact with the petroleum and are killed. Large numbers can be destroyed by spraying with whale-oil soap, one pound to three gallons of water, with a small amount of cheap sugar or syrup added to the solution. This adheres to and kills all insects it strikes.

FALSE CHINCH-BUGS.—Small, grayish-brown insects (about one-eighth of an inch long when fully grown), which perforate the vine leaves. They drop to the ground when the vine is disturbed. They may be caught by shaking into a dish-shaped screen placed under the vine, or a spray like that for the vine hopper may be used on the vine and ground beneath.

GRASSHOPPERS.—These pests often invade orchard and vineyard, and sometimes kill the plants outright by completely defoliating them. This plague has been successfully met by the use of the arsenic and bran remedy, prepared as follows: Forty pounds of bran, fifteen pounds middlings, two gallons of cheap syrup, twenty pounds arsenic, mixed soft with water; a tablespoonful thrown by the side of each vine or tree. Cost per acre for trees, twenty-five cents; for vines, fifty cents. If placed on shingles about the vineyard, much of the poison not eaten may be afterward gathered up and saved. Complete success has resulted from the use of this remedy, as the grasshoppers

eat it readily and die in their tracks. For this remedy may be substituted, with equal effect, the Paris green spray.*

RED SPIDER AND OTHER MITES.—Very minute insects usually discernible only with the aid of a magnifier, sometimes destroy the leaves, causing them to lose their color and health by their inroads upon the leaf surface. The red spider and yellow mite are conspicuous examples; the former infests nearly all orchard trees, especially the almond, prune, plum; and the latter, the pear. The eggs of the red spider are ruby-red globules, as seen with the magnifier, and are deposited in vast numbers upon the bark of the tree, and leave a red color upon the finger if it is rubbed over them. The eggs are very hard to kill, and treatment is most effective when applied in the spring and summer, after the mites are hatched out. Mr. Klee recommended the sulphide of soda and soap wash (see page 239), applied twice in the year, in June and September, using as much sulphur as the solution will carry. The popular remedy is a thorough dusting of the trees with sulphur, after spraying with cold water.



THE RED SPIDER—YOUNG AND MATURE, HIGHLY MAGNIFIED.

PHYLLOXERA.—This pest of the grape-vine is closely allied to the aphides, and lives both upon the root and leaf, though in this State the root type prevails and the leaf form is seldom seen. No remedy has yet been found effectual, but escape is had by using roots resisting the insect, as described on page 375. The insects are recognized, by the aid of a magnifier, as minute yellow lice, chiefly on the rootlets.

*For the protection of nurseries, orchards, and vineyards it is often necessary to resort to various devices for excluding the grasshopper, or for destroying them upon adjoining fields. Publications describing such devices may be had free by addressing the Secretary of Agriculture, Washington, D. C.

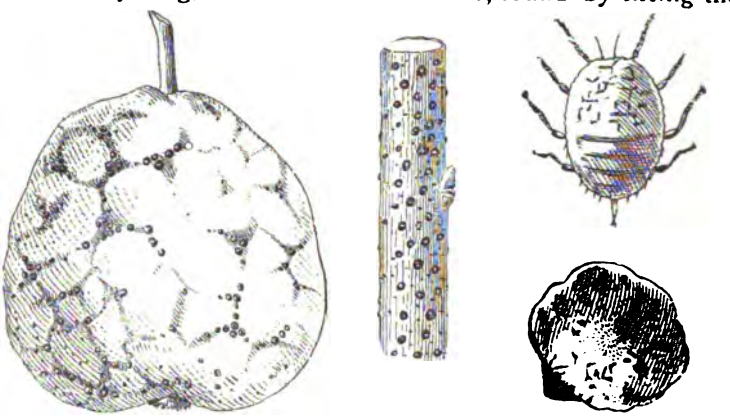
THE WOOLLY APHIS.—A louse of dark red color occurring in groups covered with a woolly substance which exudes from the bodies of the insects. In the engraving, *a* is the gall or swelling produced on the rootlets by their presence; *b* is the insect showing the outgrowth of woolly matter; *c* is the winged female. The woolly aphis is an almost universal pest of the apple, though, as stated on page 102, some varieties are practically exempt from it. As the pest lives both upon root and top, its annihilation is impossible, but it may be reduced so that the fruitfulness and vigor of the tree are not impaired. The use of wood ashes around the tree close to the trunk has been beneficial, and a dressing of gas lime very sparingly applied at a distance from the trunk, has also had a good effect. The insect on the branches and twigs can be reduced by spraying with resin solution (already mentioned for leaf aphides), or the clusters of the insect can be touched with a swab dipped in kerosene, but the kerosene should not be allowed to spread upon the bark. Lady-birds often clear away the woolly aphis of the tree above-ground.

THE WOOLLY APHIS AND INJURED ROOTS.

SCALE INSECTS.—This is a large group of pests which occasion greater loss and trouble to our fruit growers than all other pests combined. There are many species, and no orchard tree is exempt from the attacks of one or more of them, though some trees are apparently more popular with the pests than others. The fruit grower should study their life history and classification as laid down in the works on etomology. It will only be possible in this connection to introduce a few engravings, by which some of the most prominent pests can be recognized, and to give some of the remedies which are now being most successfully employed against them.

SAN JOSE SCALE (*Aspidiotus perniciosus*).—This is one of the worst, and, to-day, the most widespread, of the species of scales which are found preying on deciduous fruit trees in California. The work of this species is generally readily distinguished from other species of scale by the red blotches which are formed wherever it stings any part of the tree—either branch, leaf, or fruit. These red blotches are more pronounced in some varieties than in others. When the scales are present in large numbers,

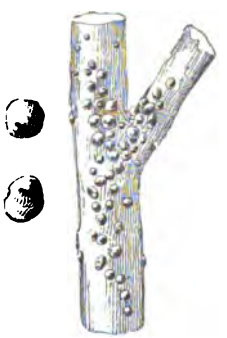
it causes a complete discoloration of the bark clear to the sap-wood. This scale, like others, has its preference among the deciduous fruits, which it affects most severely. The apricot is the only one which, it may be said, is proof against it; certain varieties of cherries and plums are but little affected, the reason being, probably, that the bark is too compact for the scale to pierce it with its proboscis. The engravings show a pear affected by the scale; also the insect natural size on a twig; also the form of the young, and the mature female, found by lifting the



SAN JOSE SCALE ON FRUIT AND TWIG; YOUNG SCALE AND MATURE FEMALE

scale, the color of the insects being lemon yellow. The scale of the female is about one-sixteenth of an inch in diameter, with a yellowish center and gray or black margin.

THE GREEDY OR WHITE PEAR SCALE (*Aspidiotus rapax*). —This species affects many kinds of trees, deciduous as well as evergreens. Scale, about one-sixteenth of an inch in length; form, ovoid; color, drab; female, bright yellow. This insect is found in many places along the coast. It infests, chiefly, pear trees, hence its name. It is distinguishable easily from the *Aspidiotus perniciosus* by its whitish yellow color, contrasting with the dark color of the latter. Generally this scale has only one brood in the season, and, as compared with the San Jose scale, it is of little danger, owing to its slow breeding propensities.



PEAR SCALE.

OYSTER SHELL SCALE OF APPLE (*Mytilaspis pomorum*). —This is one of the few insects which the Northeastern States

have in common with us. Like the preceding one, it has only one brood during the season. It affects the apple chiefly, although sometimes the pear also. It is confined chiefly to the coast counties, but is also found in other places, as San Joaquin Valley. Owing to the thickness of the armor, it is one of the most difficult of the scales to exterminate. It can be easily recognized by the engraving, which shows a piece of bark covered with it. The best remedy is a winter spray of one-half pound of caustic soda and one-half pound of commercial potash to each gallon of water used.

OYSTER SHELL SCALE.

ROSE AND BERRY SCALE (*Diaspis rosæ*).—The engraving, Fig. 2, page 562, will enable one to easily recognize this scale. The large white scale is that of the female, the elongated one with ridges is the male. The rose scale infests, besides roses, various fruit bushes, especially blackberries and raspberries. Remedy: For raspberries and blackberries the cutting down of the canes to the ground should be adopted, and the stumps sprayed or washed with kerosene emulsion, recommended under the head of general remedies for scale insects.

OLEANDER SCALE (*Aspidiotus nerii*).—This scale is well shown in Fig. 3, page 562. It affects a great many trees, especially evergreens. Lemon trees become badly affected by it, and the fruit is sometimes completely covered with it. The olive is also subject to it, and the fruit of the olive when infested does

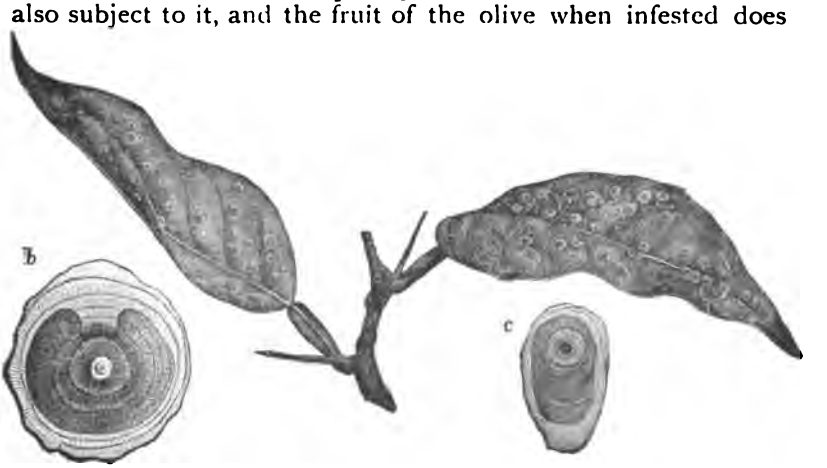
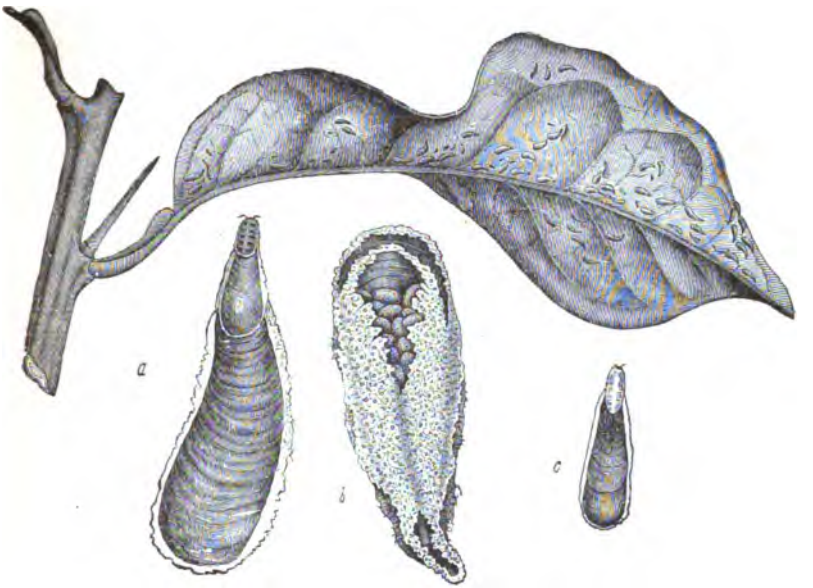


FIG. 1. RED SCALE OF THE ORANGE.

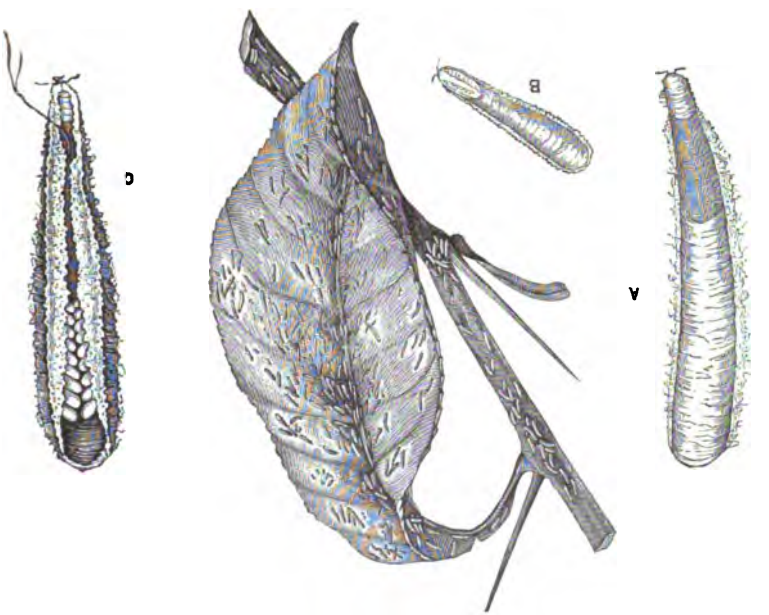
not mature well, and wherever a scale is found, a green blotch shows its appearance. This is the only scale affecting the olive in the dry interior valleys.

FIG. 2. ROSE AND BERRY SCALE.

FIG. 3. OLEANDER SCALE.



THE PURPLE SCALE OF THE ORANGE.



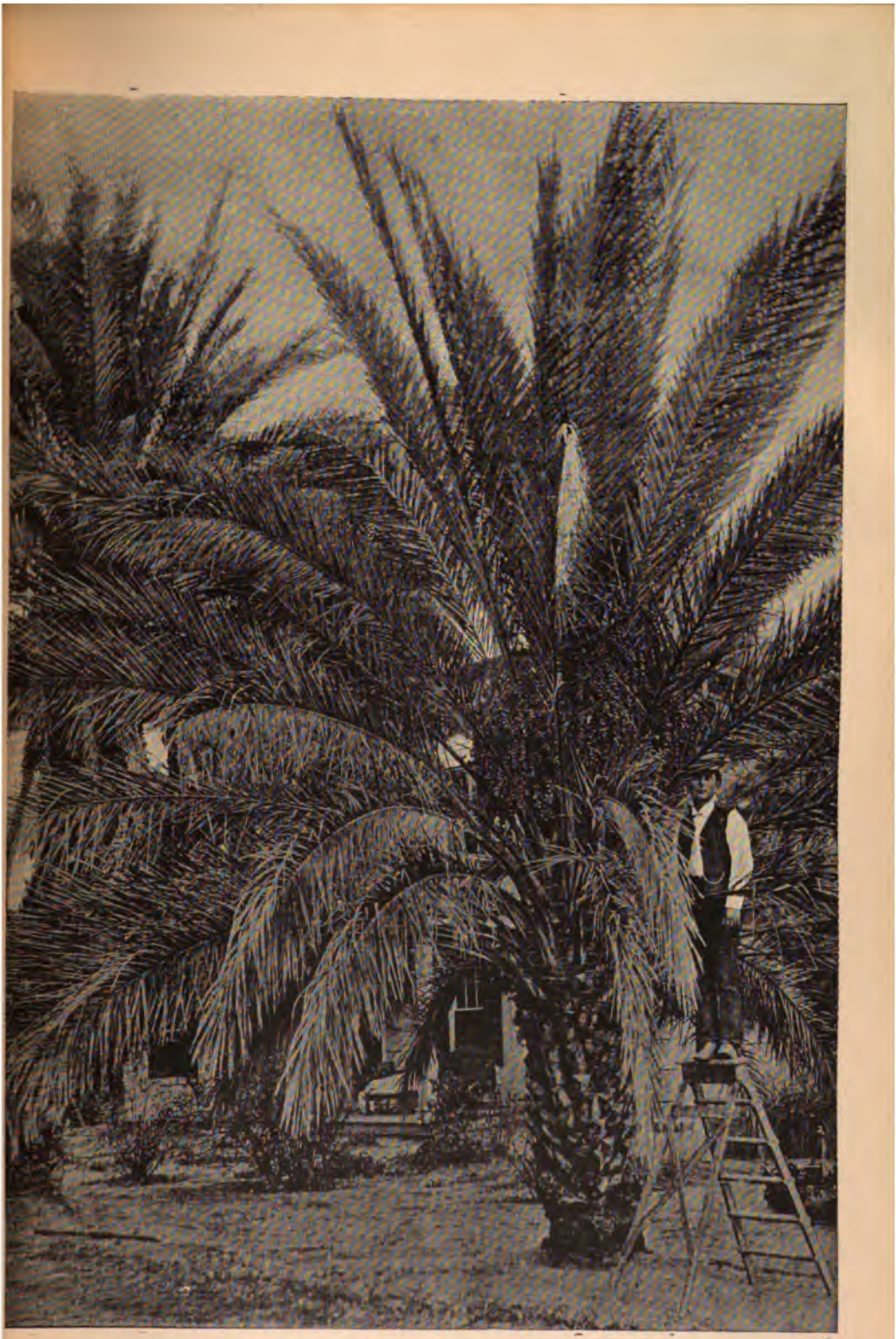
LONG SCALE OF CITRUS TREES.

RED SCALE OF ORANGE AND LEMON (*Aonidia aurantii*).—This scale, shown in Fig. 1, page 561, affects citrus trees in both the coast and interior regions. The scale fully grown is one-twelfth of an inch or a little more in diameter, center yellow, margin light brown. The appearance of trees infested with this pest is very striking, very much resembling those diseased from other causes, such as bad drainage, the leaf presenting a mottled appearance, a light blotch around the scale contrasting with the natural green of the leaf. The branches are but little troubled, but the fruit, like the leaf, becomes completely covered with the insects. An orange tree infested with this scale gradually becomes sickly and languishes.

OTHER CITRUS TREE SCALES.—The two scales pictured on page 563, have been recently brought into this State from Florida. The "purple scale" is *Aspidiotus citricola* and the "long scale" is *Aspidiotus gloverii*." They can be destroyed with the remedies commended for other scales on citrus trees.

BLACK SCALE OF THE OLIVE, ETC.

THE BLACK SCALE (*Lecanium oleæ*).—This scale, shown on this page, is almost a universal pest, especially in regions adja-



BEARING DATE PALM OF J. R. WOLFSKILL.—See page 406.

cent to the coast. It affects citrus fruit trees and some deciduous trees as well, and a fungus growing on its exudation causes the black smut, which renders tree and fruit unsightly; but this smut accompanies other scale insects as well as this one. It is especially troublesome on the olive, and will quickly spread to ornamental plants and vines in the garden.

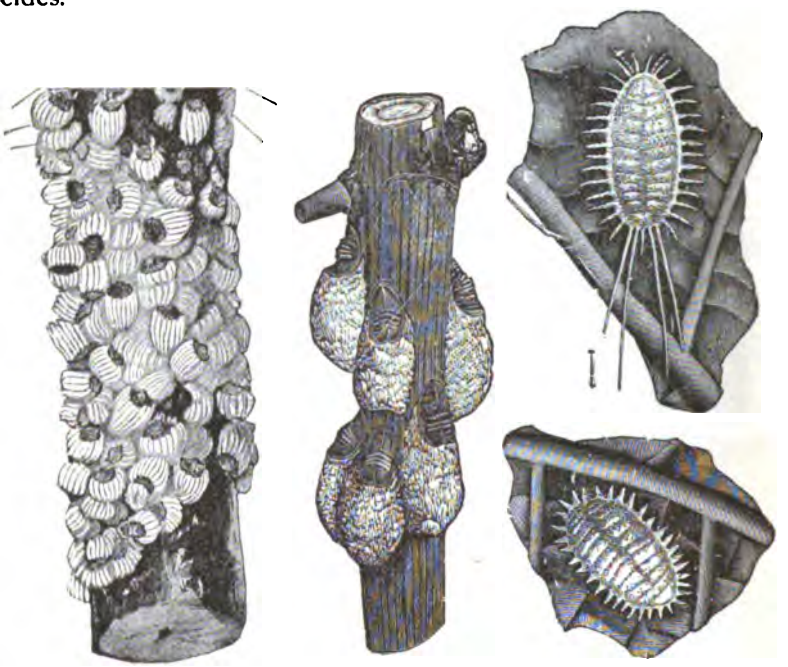
SOFT ORANGE SCALE (*Lecanium Hesperidum*).—This scale, Fig. 2, page 567, is a pest of citrus trees the world over. The scale is ovoid, a little wider at one end than at the other; length, from one-twelfth to one-seventh of an inch; color, dark brown on convex part, and a lighter brown surrounding margin; it has two indentations on each side, and one on posterior end. The engraving does not bring out these characters well, but shows the way in which the scale collects in masses.

BROWN APRICOT SCALE.—The apricot tree, though defying the most ruinous scales of some other trees, is now beset by a scale of the *lecanium* family, somewhat resembling the soft-orange scale in exterior appearance. The scale shown on this page is boat-shaped, when reaching maturity wrinkled; the color is a shiny brown, darker in the center, lighter at the edges. A full-sized scale has a length of a quarter of an inch, and a width of one-eighth of an inch. The eggs generally hatch in May and June, and the main brood is produced in a few weeks. This scale attacks nearly all kinds of deciduous fruits, but seems to be especially adapted to the prune and apricot.

BROWN APRICOT SCALE.

COTTONY CUSHION SCALE OR FLUTED SCALE (*Icerya Purchasi*).—This most grievous of all scales in its rapid increase and wide range of food plants, can be easily recognized by aid of the engraving. It is distinguished from the cottony grape scale by the fact that the egg sac of the former is fluted, or ribbed lengthwise, while the latter is merely a cottony mass. The fullest investigation of this scale has been

made by Professor Riley, United States Entomologist,* and to his enterprise in sending an agent to Australia is due the fact that an imported lady bird (*Vedalia cardinalis*) has destroyed this pest, which is exceedingly difficult to repress with insecticides.



COTTONY CUSHION SCALE. COTTONY GRAPE SCALE. MEALY BUGS.

FILBERT SCALE (*Lecanium hemisphericum*).—This large, roundish scale, shown in Fig. 1, page 567, is abundant on the native oaks, and is sometimes found on fruit trees, but thus far has not been found a formidable pest.

MEALY BUGS.—Closely allied to the scales are the mealy bugs (species of *dactylopius*), soft and of a pale pink color, generally covered with a whitish mealy powder, hence the name. The common species is found in nearly every greenhouse in the world, and in California climate lives in the open air on many kinds of plants, and have at various times proved quite troublesome. Unless checked by natural enemies, the mealy bugs multiply very rapidly, and mass themselves in the corners of the

*Report United States Department Agriculture, 1886, p. 466.

leaves. The plants turn black from the fungus growth growing on the honeydew, and the bush presents the same appearance as a scale-infested plant. With the aid of a magnifier the appearance of the mealy bugs, as shown on the preceding page, can be readily recognized.

FIG. 1. FILBERT SCALE.

FIG. 2. SOFT ORANGE SCALE.

REMEDIES FOR SCALE INSECTS.—Though most of the scale insects are attacked by parasitic and predacious insects, these natural agencies have not thus far proved rapid enough to cope with the increase of the scales, and insecticides have to be employed to save the fruit and trees. The subject of spraying and appliances therefore is considered at length in the publications of the State Board of Horticulture and the United States Department of Agriculture, and too many considerations are involved to admit of recital in this place. The treatment depends upon the condition of the tree. Upon deciduous trees strong mixtures may be used as winter washes, and washes of different character as summer washes. There is a vast number of these

washes, all of which will do good work if thoroughly applied, which is usually the secret of success. A few will be given herewith:—

WINTER WASHES FOR DECIDUOUS TREES.

CAUSTIC SODA AND POTASH.—One pound of concentrated lye (American), of eighty per cent; or four-fifths of a pound of Greenbank powered caustic soda, of ninety eight per cent; or one pound of solid caustic soda, of seventy-six per cent; or one and one-half pounds of solid caustic soda, of sixty-three per cent. These varying proportions are given because the caustic soda in the markets are of different strength and purity. Whichever one is chosen, add to each amount named one-half pound of commercial potash and dissolve in six gallons of water. One advantage of using the potash with the soda is that the former collects moisture and keeps the compound acting when the soda alone would dry and crystallize and cease working on the scale.

WHALE-OIL SOAP AND CAUSTIC.—To this mixture of soda and potash, for deciduous trees perfectly dormant, one-fourth of a pound of whale-oil soap can be added to each gallon of the solution with advantage.

LIME, SALT AND SULPHUR REMEDY.—The following formula has been used with great success throughout the State: Forty pounds of unslacked lime, twenty pounds of sulphur, fifteen pounds common stock salt, water to make sixty gallons. Boil ten pounds of lime and the twenty pounds of sulphur in twenty gallons of water for half an hour or more, or until both lime and sulphur are dissolved. The sulphur must be thoroughly dissolved and mixed with the lime; the mixture will then be of an amber color. Then slack in an empty half barrel thirty pounds of lime with soft hot water, using enough water to thoroughly slacken the lime, and keep it in a liquid form. After the lime is slacked, add fifteen pounds of common stock salt while the material is still hot. When the salt is well dissolved, mix the two lots together with sufficient water to make sixty gallons of spraying material, which will then be a thin whitewash. The material should be strained, after being thoroughly mixed, through a fine wire strainer. Apply the wash milk-warm or warmer, with a spray pump. Use only when foliage is off the tree.

SUMMER WASHES FOR DECIDUOUS TREES.

SULPHIDE OF SODA WASH.—The wash for which a formula is given on page 239, is also a most effective summer wash for scales just as they are hatching out.

RESIN SOAP.—Ingredients for one barrel of fifty (measure) gallons. Weight, about four hundred and fifty to five hundred pounds. Ten pounds caustic soda, ninety-eight per cent; ten pounds potash; forty pounds tallow; forty pounds resin. *First*, dissolve the potash and soda in ten gallons of water. When dissolved, place the whole amount in a barrel to be used. *Second*, dissolve the tallow and resin together. When dissolved, add the same to the potash and soda in the barrel, and stir well for five minutes or so. Leave standing for about two hours; then fill up with water, stirring well as every bucket of water goes in. Use the following day, one pound to the gallon of water. Apply warm. Commended by Sol Runyon.

KEROSENE EMULSION.—Recommended by Dr. Riley and made according to the Hubbard formula, as follows (Report of the Department of Agriculture, 1884, p. 331):—

Kerosene, 2 gallons	67 per cent.
Common soap, or whale oil soap, ½ lb. } Water, 1 gallon }	33 "

Heat the solution of soap and add it boiling hot to the kerosene. Churn the mixture by means of a force pump and spray nozzle for five or ten minutes. The emulsion, if perfect, forms a cream, which thickens on cooling, and should adhere without oiliness to the surface of glass. Dilute before using, one part of the emulsion with nine parts of cold water. To obtain this emulsion in proper form violent agitation is necessary, the time required depending on the violence of the agitation and temperature of the mixture. Prof. Cook's formula is this: "Dissolve in two quarts of water one quart of soft soap or one-fourth pound of hard soap by heating to the boiling point,

then add one pint of kerosene oil and stir violently from three to five minutes." This is best done by use of the force pump, as recommended in preparing the Hubbard formula. "This mixes the oil permanently, so that it will never separate, and can be diluted easily, at pleasure, by simply shaking or slightly stirring after adding the water to dilute it."

WASHES FOR SCALES ON OLIVE, ORANGE, ETC.

MR. COOPER'S KEROSENE MIXTURE.—Five gallons best kerosene oil, one hundred and fifty degrees test; one and one-fourth pounds good common soap, or one bar and a half of soap usually sold as pound packages; two and one-half gallons of water. This makes the emulsion. When using, dilute six and one-half (to seven) gallons of water for each gallon of oil, and to this mixture add two and one-half pounds of good home-made soap dissolved in boiling water. All this mixing is done with hot water, and is applied at a temperature of one hundred and forty degrees Fahr. Commended by Ellwood Cooper. Care must be taken to use the best kerosene.

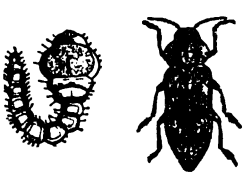
TOBACCO TEA.—Make a decoction of tobacco stems by boiling the stems until all their substance has been extracted, after which the decoction is strained through a piece of coarse muslin cloth and cold water added until the decoction contains two gallons to each one pound of tobacco stems used. These stems can usually be obtained at cigar factories at about two cents per pound.

RESIN SOAP.—Take twenty pounds of resin, one gallon of fish oil, eight pounds of caustic soda, and enough water to make one hundred gallons. The caustic soda is first dissolved in about sixteen gallons of water, after which one-half of the solution is taken out and the resin added to that remaining in the kettle. When all of the resin is dissolved, the fish oil is added to it and the whole thoroughly stirred, after which the balance of the caustic soda solution is added very slowly and boiled for about an hour, or until it will readily mix with water. Better results will be obtained if an iron vessel is used for making the preparation in than if a tin one is used, since a considerable degree of heat is necessary in order to produce complete saponification of all the materials used. This wash has been quite extensively used and has given quite good satisfaction. Commended by D. W. Coquillett.

PROPRIETARY REMEDIES.—A number of proprietary remedies are upon the market, many of which are, no doubt, effective.

INSECTS BORING IN TWIG, STEM, OR ROOT.

THE COMMON BORER.—The insect which has done most injury in this State is the "flat-headed apple borer" (*Chrysobothris femorata*). It affects chiefly apples, peaches, and plums, which have been injured by sunburn. It is a pale-colored grub with a brown head, the forepart of the body being greatly flattened. The matured beetle is greenish black or bronze colored, copper colored on the under side. If any tree receives any damage to the bark, either by sunburn or other causes, the borer is sure to find it, and it works itself into the tree, its castings being the only guide to its presence. The best remedy is prevention by protection from sunburn, as described on page 150. A whitewash containing whale-oil soap and sulphur is also a good protection and preventive. Whenever a



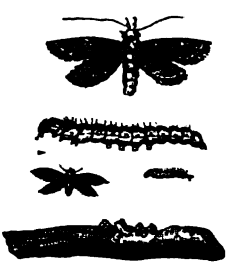
FLAT-HEADED BORER AND BEETLE.

borer is removed, the *débris* and dead wood should be entirely cleaned out and the smooth surface left, taking care to preserve the bark as much as possible. Then the wound should be smeared over with grafting wax, and a rag tied about it. In this manner young trees have been saved, but if seriously attacked, it is better to put in a sound tree and protect it.

SUN-SCALD BORER.—Another borer which delights in sun-burned trees is a minute beetle, making a burrow hardly larger than a pin-hole. It is known as the sun-scald beetle (*Xyloborus xylographus*). The remedy, as in the former case, is to prevent injury to the bark, for this precedes the attack of the beetle.

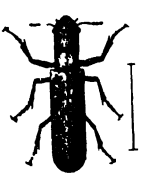
SUN-SCALD BEETLE.

PEACH TWIG-BORER.—This grub is the larva of a moth (*Anarsia lineatella*) about half an inch in length when fully grown, and of a light reddish color. The moth, the worm (natural size and enlarged), and the manner of its working in the peach or apricot twigs, are shown in the engraving. The first brood of worms bore into young limbs of peach trees, the second into the fruit. Any infested limbs should be cut off and burned, and no hiding-places for the insects allowed. It is in the spring that they show their work most plainly by the withering young shoots. These must be cut off and destroyed. The insect is intermittent in its appearance, apparently being greatly reduced by some natural causes.



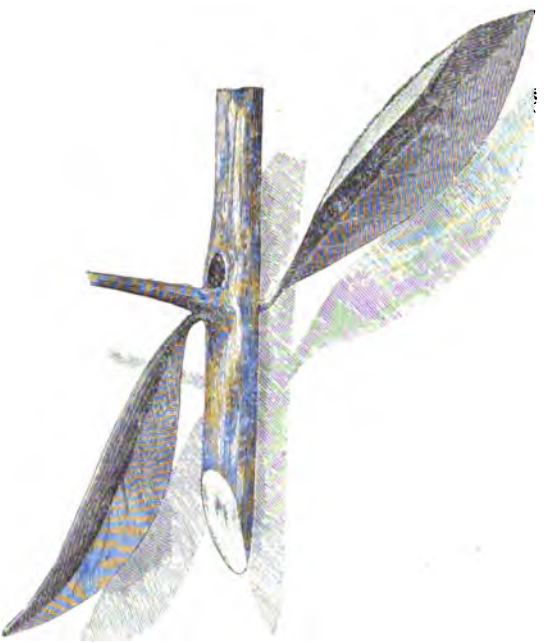
THE PEACH TWIG-BORER.

THE OLIVE TWIG-BORER.—A reddish brown beetle boring into twigs of olive and other orchard trees, at the axils of the leaves. The insect is shown in the engraving, somewhat enlarged, as the line on the left shows the natural length of the insect. It is *Polycaon confertus*, and it breeds in decaying logs and stumps, apparently visiting the fruit trees merely to gratify its appetite. Its work is not fatal to the tree, but unless proper pruning and attention be afterwards given, it may spoil the shape of a young tree. Remove the affected branches below the burrow of the beetle, or if it would be difficult to replace a branch, see that the beetle is destroyed and the entrance to the hole stopped up—this to prevent decay and a weak branch following. Spraying with ill-smelling solutions may prevent their attack until the material leaves the tree, and



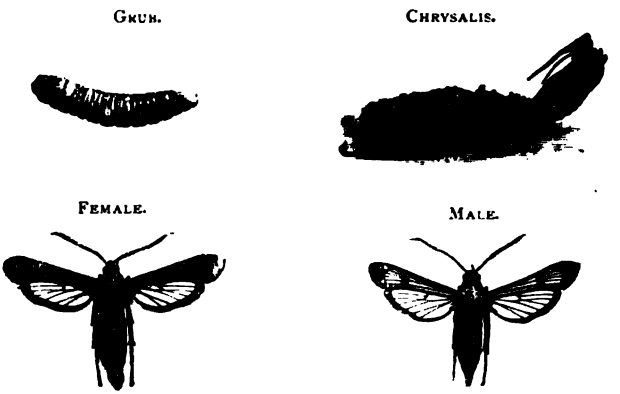
OLIVE TWIG-BORER.

may at times be used to advantage. Clearing away of decaying stumps, etc., may reduce the pest. It has been found to breed in old grape-vine stumps piled up for firewood.



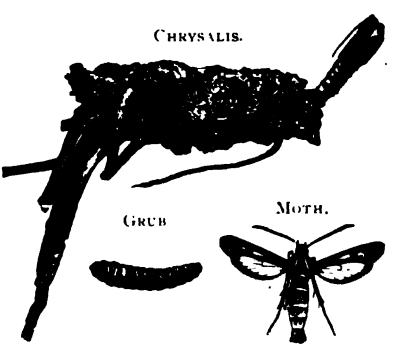
WORK OF THE OLIVE TWIG-BORER.

PEACH CROWN-BORER.—A grub boring into peach trees just below the ground surface, its presence being shown by copious gumming. The insect resembles the Eastern crown-borer of the peach, but is a distinct species (*Sannania pacifica*, Riley). Mr. Klee shows that it burrows vertically, and therefore not so likely to girdle the tree as the Eastern species. The engravings show the grub, the chrysalis, the female and male, clear-winged moths. Remove the ground around the tree, dig out the grubs, and cover the wound with clay or wax. To prevent the deposit of eggs, encircle the tree for six inches above and below the ground with tarred paper, tying it securely. Piling sand or ashes around the tree may be useful.



California Peach-Borer.

Strawberry Root-Borer.—The larva of another clear-winged moth (*Ægeria impropria*), boring into the root of strawberry plants, found in various portions of the State, and doing considerable damage, forcing the growers to resort to replanting much earlier than otherwise would be necessary. Mr. Klee says the common practice of flooding the vines has a great tendency to kill out the worms, and if the water was retained, say four to five days during the winter, all over the plants, doubtless all the larvæ would be killed.

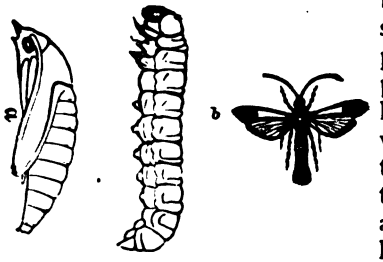


California Strawberry Root-Borer.

Currant and Gooseberry Borer.—A white worm eating out the central pith of currant and gooseberry plants —the larva of another clear-winged moth (*Ægeria tipuliformis*). Spraying with whale-oil soap after the crop is gathered, pruning out and burning in the fall of all old wood which can be spared, will reduce the evil. (See figure on the following page.)

INSECTS DEVOURING THE PULP OF FRUITS.

The Apple Worm.—The codlin moth (*Carpocapsa pomonella*) is one of the great pests of the State. Its appearance and



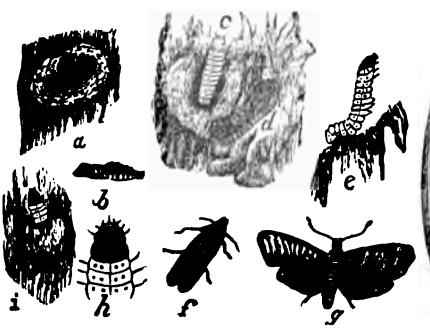
MOTH OF CURRANT-BORER, LARVA AND PUPA ENLARGED.

manner of work are sufficiently shown by the engraving. It preys chiefly upon the apple and pear, but the quince and other large fruits are sometimes invaded by it. The first moths of the season usually appear about the blossoming-time of the apple and deposit their eggs in the calyx of the young fruit, but in the cooler parts of the State the moth is apparently considerably delayed in transformation, and deposits its eggs at random on the skin of the fruit. The young worm hatches in seven to ten days, and eats its way into the fruit, and in twenty days its full growth is attained, and it goes out through the side of the apple, and, by means of its spinneret, reaches the ground or some large branch. If landed on the ground, it usually seeks the trunk, which it ascends and soon finds a hiding-place under the loose bark, where it spins its cocoon, and in eight or ten days comes forth a moth, ready to lay eggs anew. The egg is laid all over the fruit, and especially at a point where two fruits touch. Usually we have in this State two broods, at least, but more often three, and, naturally, if unchecked, the increase from the first to the last is enormous. The worms escaping from the fruit in the fall hibernate as larvæ under the loose bark of the tree, or in storehouses, or in any available dry place.

THE APPLE WORM AND ITS PARENT MOTH.

On old trees with loose bark the worms find abundant shelter, and in treating such an orchard it is desirable to scrape away the old bark, burn the scrapings, and spray with a mixture of whale-oil soap and sulphur to soak and kill any worms which may be overlooked. The engravings show how the worm conceals itself and spins in bark crevices, also an implement which is well adapted for cleaning the bark from old trees.

The remedies now prevailing against the codlin moth are banding the trunks of the trees with burlaps—making harbors, in which the worms hide and spin their cocoons. Wrap a piece of an old sack around the tree trunk, fastening it with a piece of twine about the middle of the band, so that worms crawling either up or down may run under it. Remove the bands regularly once a week, crush all the worms, and replace the band. It has been found that the worms under the bands are attacked by predaceous insects, which aid in the destruction, and such should be observed and spared. Mr. G. W. Thissell, of Winters, has patented a trap of wire cloth, which, when placed around the tree, allows the worms to enter. They find a snug harbor, but when they change to moths, the hole which let in the worm is



THE APPLE WORM IN OLD BARK.

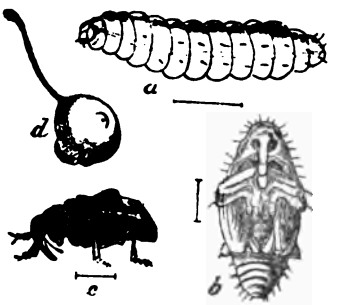
SCRAPER FOR REMOVING OLD BARK.

too small to let out the moth. The trap works well, but has not come into wide use yet, because of cost and necessity of skillful adjustment. Its efficacy is, however, quite well established.

A treatment for the worm now quite widely employed is to spray the trees thoroughly with Paris green, one pound to two hundred or two hundred and fifty gallons of water, keeping the liquid thoroughly stirred. One spraying just before the small apples turn downward, seems to be effective for early varieties. Late apples should be sprayed two or three times, the last time in July. Injury to leaves by Paris green seems to differ with different varieties, and to be greater in the moist coast region than in the interior. London purple is also used by some growers with a strength of one pound to two hundred and twenty-five gallons.

THE PEACH WORM.—As already stated, the larva of the peach moth, which early in the spring bores into the twigs, is sometimes found later in the season in the flesh of the peach.

THE PLUM CURCULIO.—Although, as has been stated, the presence of the plum curculio has not been detected in this State, and although the impression prevails that local conditions do not favor its existence, an engraving showing the insect and its work is introduced, so that all fruit growers may be watchful. The most characteristic and easily-recognized sign is the crescent inclosing the puncture in which the egg is placed, as shown on the young plum, *d*. The larva is shown at *a*, the pupa *b*, and the beetle *c*—all highly magnified.



THE PLUM CURCULIO.

THE DIABROTICA.—A light green beetle with twelve spots on his back (*Diabrotica soror*), is sometimes very injurious to early fruit, by eating into it when ripe. The insect also eats leaves and blossoms. As the insect attacks the fruit just when it is ready to pick, it is impossible to apply any disagreeable or poisonous spray. Sometimes the insects are driven away by dense smoke from fires in and around the orchard.

DIABROTICAS, SOROR AND 3 VITATTA.

THE DRIED FRUIT WORM.—Dried fruit is often seriously injured after packing, by a small worm larva of a moth not yet determined. The eggs are deposited on the fruit either while drying or while in the packing-house, or through the cloth of the sacks, or seams of the package. The only remedy is to kill the eggs on the fruit before packing, by dipping in boiling water, or by heating in an oven and after that preventing the access of the moth. Some packers claim that fruit packed under good pressure will not be injured, except, perhaps, around the outside.

BENEFICIAL INSECTS.

Nearly, if not quite all, injurious insects have foes of their own kind which reduce their numbers. Works on entomology describe many of them, and the observing grower cannot employ his leisure time more profitably than in keeping his eyes open and studying for himself the insect world around him.

THE FIG INSECT.—Since the paragraph on the caprification of the fig (page 419) was printed, the fig insect *(blastophaga psenes)* has been received from Smyrna by Mr. James Shinn, of Niles, Alameda County, and set free in a large *capri* fig tree growing on his place. Thus we have secured the agent for making local tests of the efficiency of caprification.

CHAPTER XXXVIII.

SUPPRESSION OF INJURIOUS ANIMALS AND BIRDS.

THE beasts of the field and the fowls of the air are sometimes such grievous trespassers upon the fruit plantation that protection has to be sought against them. The animals which figure in this evil work are mainly species of *rodentia*, some of them burrowers, as, for example, the ground squirrel and gopher; others, surface dwellers, like the hare or jackass rabbit. Occasionally there is injury done by deer in the orchard and vineyard, and coons in the melon patch, but these larger animals may usually be left to the hunters and the dogs.

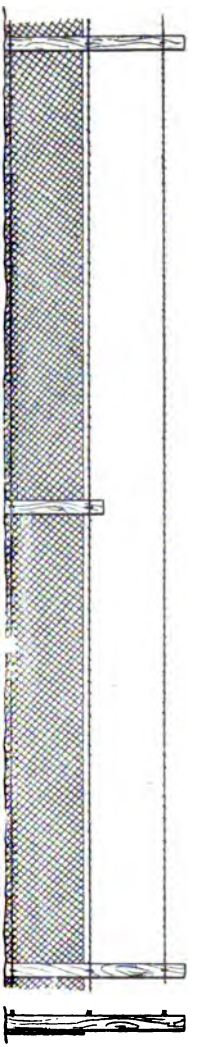
RABBITS.

Though there are three species prevalent, none are burrowers. This fact has led to united efforts at their suppression by driving them, with mounted horsemen, from a wide stretch of country into a narrow, fenced inclosure, where they are killed with clubs. During the last two years tens of thousands have been killed in this way, and comparatively few are now found in the localities where the method has been adopted. Still, however, there are plenty at large to vex the fruit planter, and he must protect himself against them.

RABBIT FENCES.—The surest protection against rabbits is a fence which prevents their entrance, and many miles of such fence have been built in this State. Several styles prevail. The ordinary board fence, with the boards running horizontally, is made rabbit-proof by placing the lower boards close together, with openings of but about two inches between them. A barbed wire, with barbs about two and one-half inches apart, can be used to advantage by running it along at or a little below the surface of the ground to prevent scratching under.

The cost of board fences has led to the use of barbed wire and wire netting, or of perpendicular slats interwoven with wire. Such materials are sold in large quantities. A very effective combination of barbed wire and netting, which is used in the upper San Joaquin Valley, is shown in the adjacent engraving, and described as follows:—

The tall posts are regular split redwood posts. The intermediate small ones are made by sawing in two the regular posts and splitting them into eight small posts, or, rather, large stakes. The netting is of galvanized wire, No. 19 gauge, and one and one-half-inch mesh. This netting is stapled to the posts and stakes on the *inside*, or toward the field. This is of prime importance, as it *will not serve the purpose* if it is placed on the *outside*. The bottom of the netting is to come down to the ground, and the ground must be left hard, and not plowed, to prevent burrowing or scratching the dirt from underneath, which can be easily done if the dirt is softened up. It is not at all necessary to set the netting below the ground. In the sketch are shown three barbed wires, with barbs two and a half inches apart. These wires must be placed on the *outside* of the posts. This position is also a prime necessity. The lower wire is stretched just clear of the surface of the ground. The middle wire is one inch higher than the top of the netting, and the top wire, which is intended only as against cattle, is at a height suitable for the purpose. The rabbit-proof portion is comprised in the netting and the two lower wires. Hence if cattle are not feared, and rabbits are the only foe, the top wire can be dispensed with, and the posts can be all short with a greater proportion of stakes, having only enough stout posts to stand the strain of the wires. The theory of this construction is that a rabbit can only pass the fence over the top or under the bottom of the netting, and this is effectually prevented by the barbed wires, which tear the animal if it attempts either to leap or climb over, or to scratch under.



A RABBIT-PROOF FENCE IN SUCCESSFUL USE IN MIRAMONTE COLONY, KERN COUNTY.

SMEARS DISTASTEFUL TO RABBITS.—Where the expense of a fence cannot be assumed, measurable protection can be had by sprinkling the leaves or smearing the stems of plants with substances distasteful to the animals, which are quite dainty in this respect. Commercial aloes, one pound to four gallons of water, both sprinkled on leaves and painted on the bark, gives a bitter taste, which repels rabbits. A tea made by steeping quassia chips is said to produce the same effect. Rancid grease, liquid manure, putrescent flesh or blood, have been approved as a daub for tree trunks, but the efficacy is only of limited duration.

RABBIT POISON.—Pieces of water-melon, cantaloupe, or other vegetable of which they are fond, may be poisoned with strychnine and then scattered around the orchard. Rabbits will not touch the bark as long as they can find this bait, and one meal is effective, for the rabbit never gets far away from it. The same results can be attained by the following mixture: To one

hundred pounds of wheat take nine gallons of water and one pound of phosphorus, one pound of sugar, and one ounce oil of rhodium. Heat the water to boiling point and let it stand all night. Next morning stir in flour sufficient to make a sort of paste. The rabbits eat it with avidity if scattered about.

Another preparation is half a teaspoonful of powdered strychnine, two teaspoonfuls of fine salt, and four of granulated sugar. Put all in a tin box and shake well. Pour in small heaps on a board. It hardens into a solid mass. They lick it for the salt, and the sugar disguises the poison, which kills great numbers.

GROUND SQUIRRELS.

Ground squirrels are poisoned by the use of the poisoned wheats which are sold in the markets, or by use of bisulphide of carbon, or "smokers," which are arranged to force smoke into the holes. A small quantity of bisulphide of carbon poured into the hole, and the hole closed with dirt, is probably the most effective squirrel killer, when the ground is wet, so that the vapor is held in the burrow. Smokers are also most effective when the soil is moist. Poisoned wheat may be prepared with phosphorus, as already described for rabbits, or can be made with strychnine, in this way: Take five quarts clean wheat, scald with water, drain. Take two-thirds cup of white sugar, dissolve with sufficient water to make a syrup, add one ounce powdered strychnine, stir thoroughly until a thin paste is formed. Pour this on the damp wheat. Stir thoroughly for at least fifteen minutes. Add one pint powdered sugar, stir, add five to ten drops oil of rhodium and five to ten drops oil of anise. Place a few grains in each squirrel hole, putting it as far in as possible.

To keep squirrels from gnawing fruit trees, or climbing and getting the fruit, tying a newspaper around the trunk of the tree, letting the paper extend out four inches at the upper edges, is said to be effective. The rattle of the paper when the squirrels attempt to get over it will frighten them.

GOPHERS.

Gophers can often be destroyed by the use of poisoned wheat, especially if prepared with a little oil of rhodium, which seems to be very attractive to all rodents. Pieces of fruits or vegetables into which a few grains of strychnine have been inserted by making a cut with a knife-blade and then squeezing it together again, are also handy conveyors of death to gophers. There are two ways to put poisoned material into a gopher runway. One is to look for fresh open holes and put in the poison as far as possible with a long-handled spoon; another is to take

a round, pointed stick and shove it in the ground near the gopher mounds until it strikes their runway, then drop in the poisoned bait. Close up the hole with some grass; level down mounds, so that if the poison does not kill all the gophers, you will soon discover their new mounds. If there are many mounds, put the poison in a number of places.

Bisulphide of carbon is also successfully used in killing gophers, though, owing to the fact that their runways are continuous and do not run down to a pocket, as does a squirrel hole, it is more difficult to make the vapor effective. Recently smokers have come into wide use and are approved by many.

TRAPPING GOPHERS.—Some are very successful in using gopher traps, of which there are several styles sold. Gophers come to the surface in the night, and generally close their holes soon after daybreak. They frequently emerge again about noon, and a third time late in the afternoon. It is best to set the trap in an open hole; still, the holes may be opened if the dirt is still fresh, with a good prospect of the gopher's return. Therefore, the trapper may make his rounds three times a day, as above indicated. Care should be exercised in preparing the hole for the insertion of the trap, a straight hole for a distance of at least ten inches, with no lateral branches, otherwise the gopher in pushing out the dirt will likely enough thrust the trap to one side, cover it up, or spring it, without being exposed to its grasp. The trapper should be supplied with at least two varieties of traps—one for the larger gophers, and the other for the smaller ones. The common iron gopher trap, which springs downward, is excellent for the former, and the small wire trap, which springs upward, is generally successful with the latter. The size of the hole is indicative of the size of the gopher. Either trap should be inserted nearly its full length into the hole, pressed down firmly, and a little dirt piled at the outer end to prevent its being easily pushed out. After the trap is set, it is well to cover the opening with some grass or weeds. Sometimes the holes require a little enlarging, but care should be taken to make the fit as close as possible, that the body of the gopher may be kept near the center, and thus more exposed to the prongs of the trap. In the fourth place, the trapper should have a small spade and a little gouge-shaped implement for trimming the hole. The "Dead-lock" gopher traps, made by L. F. White & Son, Pomona, have been widely introduced and approved.

GOPHER PITFALLS.—If gophers are abundant, large numbers can be captured in this way: Dig a trench around the orchard or vineyard about the width of a spade and from fourteen to sixteen inches deep. In the bottom of the ditches, about

a hundred feet apart, sink five-gallon oil cans, leaving the tops level with the ditch bottom. The gophers migrate in the night, and in attempting to come into the inclosure will fall into the ditch and then run along the bottom until they drop into the cans. Of course the ditch must not be wider than the cans. As many as fifteen live gophers have been found in one can. The cats soon learn to help themselves out of the cans. The ditch must be kept clean, and if any roads cross the tract, set up a board at night, to compel them to tumble in the ditch. This ditch should be constructed about the first of June, when the outside feed begins to dry up, and the pests rush for the cultivated ground. With such protection from the outside, and the use of poison and traps inside, the trees and vines can be saved.

PROTECTING TREE TRUNKS.—If one has but few trees to protect, as in gardens, cylinders of wire netting placed around the trunks and buried about a foot into the ground, have been successfully used. Take wire netting two feet wide and cut it lengthwise, and put the cut edge down, so the projecting wires will keep the gopher from digging under.

DESTRUCTIVE BIRDS.

Fruit growers generally appreciate the value of insectivorous birds, but there are feathered pests which do such ruinous work in disbudding the trees in spring-time, and in destroying ripe fruit, that productive measures have to be adopted against them. The so-called "California linnet," which is not a linnet, but a finch (*Carpodacus frontalis*), a persistent destroyer of buds, and the English sparrow, infamous the world over, are probably the most grievous pests, though there are other destructive birds, including the beautiful California quail, which is protected by law, and yet must be destroyed in some parts of the State or the grape crop must be abandoned.

For the killing of the smaller birds poison is usually employed. To keep the poison out of the way of domestic fowls, take a shallow box and put it on the end of a pole four or five feet from the ground. In the box sprinkle corn meal and a very little strychnine, which mixture the birds eat and are very soon killed. It will not hurt dogs or cats to eat the dead birds, for the reason that there is not enough poison absorbed by the bird. Another plan is to put the strychnine in pieces of apple and stick them on the ends of limbs of the trees. Poisoned water has been used effectively in dry weather. Some advocate the use of the shotgun, No. 30 caliber, with a small charge of good powder and No. 10 shot. As many as five hundred linnets have been killed in two days. The advantage of this plan is that one kills linnets and not other birds, while poison kills both friends and foes.

CHAPTER XXXIX.

PROTECTION FROM WINDS AND FROSTS.

THOUGH the climate of California renders unnecessary the protection against rigorous weather which fruit growers in some other parts of the world have to provide, there is often advantage in securing shelter from winds and protection from late frosts.

The general subject of forest planting in California, and the effect of preservation and extension of our forest area upon our fruit industries, has received the attention of our best-informed growers.* The planting of shelter belts at intervals across our broad valleys at right angles to the courses of prevailing or most violent winds, has also been urged with great force. These greater enterprises and projects are beyond the scope of this treatise. It is rather concerning the planting of trees to shelter individual possessions that a few suggestions will be offered.

It has been already remarked that on the immediate coast the successful growth of fruit will sometimes be wholly dependent upon proper shelter from prevailing winds, and in regions farther from the ocean, the topography may induce strong currents of air which will illy affect trees and vines. In all such places the fruit grower should plant wind-breaks, and will find himself well repaid for the ground they occupy, by the successful production on the protected area.

In the interior valleys there is also need of shelter from occasional high winds which may visit the orchards either in summer or winter, and prove destructive both to trees and fruit. In some cases long lines of sheltering trees have been cut down because they affected the fruiting of orchard trees planted too near them, and afterwards the losses through lack of protection were far greater than would have been incurred by retaining them. Hon. E. W. Holmes, of Riverside, recently wrote as follows:†

*See, for example, the essays by Abbot Kinney, of Los Angeles County, in Reports State Board of Horticulture, 1886 and 1888.

†Riverside *Enterprise*, May, 1888.

The past one or two seasons have sent us winds more violent than had ever been known since the country has been settled by Americans, and the unwisdom of the course pursued was fully demonstrated to the satisfaction at least of those who had bearing orchards. Crops were depreciated fully one-half on an average. It is evident that the loss of fruit in the older settlement by reason of the absence of such wind-breaks would far exceed in value all that would have been lost in the past few years if the outside rows of fruit trees, rather than the wind-break, had been sacrificed. In some localities, where it has heretofore been the proud boast that "we never have hard winds to damage our trees or fruit," not only was the fruit crop almost entirely ruined, but whole orchards were literally destroyed. It is true that such localities are ordinarily exempt, but there is no telling in this country when or where wind or frost may not inflict injury, and against such possible danger there is no insurance except in the planting of wind-breaks. It is manifestly more economical in the long run to provide such protection, even though a single row of fruit trees has to be omitted to give it space. The lesson of the past season has led to the replanting, in many instances, of rows of eucalyptus on the very line where four or five years ago such trees were removed.

These remarks are applicable to all parts of the State, except, perhaps, small areas especially protected by local configuration, and their lesson should be heeded.

WHAT KIND OF TREES TO PLANT.—This is a question concerning which there is much to be learned. Data is accumulating in the growth of trees planted to test their suitability, and the future planter will have more certain ground to proceed upon than is now available. Mention will be made, however, of a few trees which are now most widely grown.

The most widely-planted shelter tree is the *Eucalyptus globulus*, or Australian blue gum. It is a rapid grower and voracious feeder, and wonderful for root extension, for which it has been roundly abused. It is doubtful, however, whether we have a better tree for high growth, and consequent large area over which its shelter will be felt. It is deficient in undergrowth, and if a close screen is desired, the planting of eucalyptus and Monterey cypress (*Cupressus macrocarpa*) is a common practice. The latter also attains good height, but its broad, thick base fills the gaps between the bare stems of the gum trees. Another tree which has often been planted with the blue gum, to supply a thick, low growth, is the pepper tree (*Schinus molle*). It is also grown in rows by itself. It makes a dense head, grows rapidly, and flourishes without much care. Trees planted eighteen feet apart will soon come together and make a dense wall of very beautiful, bright, light-green foliage. The pepper is not only a good wind-break, but also an excellent dust-catcher. Unlike most trees which are used for this purpose, it does not become laden with dust. The leaves are smooth and glossy, and therefore repel the dust particles, which, stopped in their flight by the dense foliage of the tree, instead of clinging to it drop to the ground. The growth of the pepper tree near the coast is much

slower than that of the Monterey cypress. The eucalyptus and the cypress for the coast, and the eucalyptus and pepper for the interior valleys, make, probably, as perfect a wall of foliage all the year round as can be had. The blue gum is, however, somewhat subject to frost killing, especially when young, and in very frosty places is objected to on that account. A number of other species of eucalyptus are now being planted experimentally, and probably more hardy ones will be found. The red gum (*Eucalyptus rostrata*) has already attained some popularity.

The Monterey pine (*Pinus insignis*) is a rapid, high-growing tree, and, though a native of the coast, has proved itself well adapted to the interior valleys of the central portion of the State. Its foliage is dense for a pine, and its shelter, therefore, the more complete. A native white cedar (*Libocedrus decurrens*) has also been employed as a shelter tree in the San Joaquin Valley, and is commended as a rapid grower in the interior as on the coast. Its ability to stand drought, heat, and frost, is said to exceed that of any of the conifers of the sea-coast. It stands well in the most exposed situations, as its roots run very deep into the earth, and it is claimed that it does not sap the fertility from the soil around its base, as with the blue gum. It is also said to be less subject to frost injury than the Monterey cypress and pine.

All the foregoing are evergreen trees, and therefore afford protection summer and winter alike. Of deciduous trees there are many which may be well employed. The California black walnut, described on page 61, makes a very satisfactory growth both in the interior and upon the coast, and is largely used for road-side planting. The California broad-leaved maple (*Acer macrophylla*) is very beautiful, rapid in growth, and dense in foliage, and the same is true of the box elder (*Acer negrundo*), but probably both trees are especially suited to the coast regions. Of the poplars, the Carolina (*Populus monilifera*) is best, because of its breadth, density of foliage, and comparative freedom from suckering. The locust (*Robinia pseudacia*) is used to some extent, but its suckering is very objectionable.

Quite a number of the larger-growing deciduous fruit trees are used to some extent along the exterior lines of orchards for the protection of the inclosure. The fig, the walnut, the chestnut, seedling almonds, and apricots, are especially commended for such use.

This enumeration is not intended to be comprehensive. There are scores of trees which are planted to a greater or less extent. Some, like the acacias and willows, are under a ban because of their liability to harbor scale insects, but this habit is, of course, also indulged in by many trees which have been mentioned, though, perhaps, to a less extent.

GROWING TREES FROM SEED.—Much that has been said in Chapter VIII will be suggestive to one who desires to grow his own shelter trees from seed. Trees from small seeds are best grown in boxes, and in many cases, as with eucalyptus and cypress especially, do best when put in permanent place when quite small. Whether put at once in permanent place, or in nursery, the land should be deeply worked and the young plant well planted and cared for.

CULTIVATION OF SHELTER TREES.—If one desires rapid growth of shelter trees, they should be cultivated the first few years as thoroughly as an orchard. Much disappointment results from allowing road-side trees to shift for themselves in a hard, dry soil. With such treatment the root extension is naturally most rapid into the cultivated orchard ground, which is undesirable. Cultivate and enrich the road-side, and the tree will grow chiefly on the waste land. At the same time the road-side will be prevented from producing vast quantities of weed seed, to be blown over the fence, and the place will have a name for neatness, which is too rare even in California.

PROTECTION FROM FROSTS.

The use of smoke from fires of rubbish and coal tar to protect vines from spring frosts in small valleys is general. The piles are prepared and fired when the thermometer drops to a dangerous point. Some use automatic electric alarms to arouse the workmen to the necessity of firing the piles. Recently recourse has been had to smoke both for orchards and vineyards in the great interior valleys, and crops of apricots and early peaches have been saved thereby. Mr. J. H. Wheeler, recently executive officer of the Viticultural Commission, gave the following suggestions:—

> Damp manure smothered with weeds makes the best smudge, and is far ahead of tar and other materials. To light the piles rapidly a small amount of kerosene should be poured on and ignited with a match or torch. If the manure is placed in old sacks or mats it will be found convenient to move when cultivating, will keep drier through rainy weather so as to be in condition for firing at the time of frosts, and may even be removed at the end of the season for use another year if desired.

PART TENTH: MISCELLANEOUS.

CHAPTER XL.

MELON GROWING.

MELONS, those delicious connecting links between the fruit and vegetable classes, reach notable size and excellence in California, and the production of them is a leading industry in certain sections of the State. The water-melon is produced in largest quantities in the Lodi district, of San Joaquin County, though respectable quantities are also grown elsewhere. The cantaloupe, or musk-melon, is a specialty in the regions of early fruits, for the product is often very profitable if it strikes the market early enough, but there is quite apt to be an oversupply.

SOILS FOR MELONS.—Melons are chiefly grown on warm and moist alluvial soils, a sedimentary deposit by recent overflow usually being very satisfactory. The surface may be sandy or gravelly—a foot or two of such material overlaying a moist adobe has often yielded excellent results. Good melons have been grown on "slickens," or mining *débris* deposited by streams, providing the layer is not too thick, or the materials too coarse. A gravelly-loam wash from adjacent hillsides is also good, and the growth on a large scale at Lodi is upon a deep, warm loam, kind in cultivation and rich in plant food—land which is now being largely planted to peaches, almonds, and other fruits which relish light soil and plenty of summer heat. Any such soil which retains enough moisture and is sufficiently removed from immediate coast influences, or protected from too prevalent low summer temperature, yields a melon of excellent size and full sweetness.

PREPARATION OF SOIL FOR MELONS.—The deep and thorough cultivation advised in preparation for planting of small fruits should be given to ground for melons. Where rainfall is light, a thorough summer fallowing the season before planting to melons gives the crop a well-prepared soil and insures it abundant moisture by holding over a part, at least, of the previous year's rainfall.

PLANTING AND CULTIVATION.—Where extra early melons are desired, a situation as free from frost as possible is selected, and the seed is planted in February, after the heaviest rains and severest cold of January, or the plants are grown under cover and planted out later. The usual time for planting is, however, in the month of March, the grower taking the chances of having to replant a case of frost-killing. The seeds of water-melons are planted five or six in a hill and covered about three inches, the hill of water-melons being about eight feet apart each way, and of cantaloupes somewhat less. When the plants are well under way, they are thinned to two or three in a hill, and sometimes extra size is attained by thinning to one or two melons to the vine, by suppressing other blooms after the earlier ones have set.

The thinning out of the plants is done at the hand-hoeing, which is usually the first cultivation which is given. Afterwards the whole ground is gone over with the cultivator, usually twice, at intervals, and the vines are then left to extend themselves, no further work being done upon them unless there is necessity of irrigation.

IRRIGATION.—Melons are usually produced on a large scale without irrigation, and even in the drier parts of the State moisture enough can be retained in the soil by cultivation, providing the seed is sown early. In some places, however, the use of a little water is of advantage in securing desirable size, and enough has been raised by a single windmill to supply ten acres, by making application directly to the hill—always stirring the soil after watering if it has any tendency to bake or become "puddled" by the use of water.

RIPENING.—The earliest water-melons usually appear in San Francisco about July 1, and from July 10 for three months the market is well supplied. The fruit ripens continuously, and when frost has not occurred to harm the vines, water-melons have been plucked as late as January 1. The crop in the Lodi district is usually counted about one car load, or one thousand two hundred marketable melons, per acre. The best market season is, of course, during the warm weather, and when the market is oversupplied, something is secured by gathering the seed from the surplus fruit. Seed is also taken from melons which ripen after the market season is over.

VARIETIES.—The most popular water-melon is known as the "Lodi melon," from the place where most largely produced. It seems to be different from the standard Eastern sorts. Good specimens usually weigh from twenty-five to thirty pounds, are

quite elongated, skin very light green and thin, flesh red, tender and sweet. Other varieties are introduced here as fast as brought out in the East, and are grown to some extent. One called the Mammoth is quite largely grown in Fresno and Tulare Counties, and has attained a size of ninety to one hundred and twenty pounds.

Several varieties of cantaloupes are grown; a green nutmeg variety, called by some the "California Netted," is the most popular, though some large yellow cantaloupes are grown. The Cassaba is grown to some extent, and is highly praised as a winter melon in regions near the coast, where it ripens late.

CHAPTER XLI.

FRUIT PACKAGES.

THOUGH there have been many committee reports and general discussions on the sizes of packages best for the different fruits, there is as yet no uniformity in the practice of growers, nor is it possible to present a statement which can be commended as complete. The growers of different localities seem to arrive at partial agreement among themselves, and the box-makers supply the sizes to suit, but there cannot be said to be any general agreement among the producers of the State. It is quite possible that there will be improvement, however, in this respect, because of the increase of distant shipments, and because uniformity in size of package in loading cars is very important.

PACKAGES FOR EASTERN SHIPMENT.

The following schedule of sizes with indication of weight of contents is approved by the California Fruit Union:—

The ends of all boxes should be made of three-fourths-inch stuff, and all cleats three-eighths-inch stuff. The sides, tops, and bottoms of cherry boxes should be of one-quarter-inch stuff, the sides made of two strips each of one-quarter-inch stuff and seven-eighths of an inch in width. Peach, pear, and plum boxes should be made of three-sixteenths-inch stuff. All the lumber used should be dressed as smooth as possible.

MEASUREMENT AND CAPACITY.

Cherry boxes, capacity ten pounds. Outside measurements—eighteen inches in length, ten and seven-eighths inches in width, three inches in depth. Inside measurements—length, sixteen and one-half inches; width, ten and three-eighths inches; depth, two and one-half inches. Recently cherries for Eastern shipment have been packed in boxes one and one-half inches deep, holding two layers of fruit.

Plum boxes, capacity twenty pounds. Outside measurements—nineteen and three-fourths inches in length, twelve and one-eighth inches in width, four and three-eighths inches in depth. Inside measurements—length, eighteen and one-half inches; width, eleven and three-fourths inches; depth, four inches.

There are four sizes of peach and apricot boxes.

First, capacity twenty-two pounds. Outside measurements—nineteen and three-fourths inches in length, twelve and one-eighth inches in width, four and three-fourths inches in depth. Inside measurements—length, eighteen and one-half inches; width, eleven and three-fourths inches; depth, four and three-eighths inches.

Second, capacity twenty-five pounds. Outside measurements—nineteen and three-fourths inches in length, twelve and one-eighth inches in width, five and one-fourth inches in depth. Inside measurements—length, eighteen and one-half inches; width, eleven and three-fourths inches; depth, four and seven-eighths inches.

Third, capacity twenty-seven pounds. Outside measurements—nineteen and three-fourths inches in length, twelve and one-eighth inches in width, five and three-fourths inches in depth. Inside measurements—length, eighteen and one-half inches; width, eleven and three-fourths inches; depth, five and three-eighths inches.

Fourth, capacity thirty pounds. Outside measurements—nineteen and three-fourths inches in length, twelve and one-eighth inches in width, six and one-fourth inches in depth. Inside measurements—length, eighteen and one-half inches; width, eleven and three-fourths inches; depth, five and seven-eighths inches.

Pear boxes, capacity forty pounds. Outside measurements—nineteen and three-fourths inches in length, twelve and one-eighth inches in width, eight and seven-eighths inches in depth. Inside measurements—length, eighteen and one-half inches; width, eleven and three-fourths inches; depth, eight and one-half inches.

PACKAGES FOR LOCAL SALE.

The sizes described above for distant shipments also prevail locally with apricot and peach boxes, and to a certain extent for other fruits sold in this State, but there are other sizes which are at present predominant, and an attempt will be made to describe some of them, as follows:—

APPLE AND PEAR.—The box now commonly used for apples and pears has top, bottom, and sides of one-quarter inch, and ends of five-eighths stuff. The length is twenty-two inches; ends, ten by twelve inches. This is a free box for apples and pears, and is called a fifty-pound box, but it contains less weight. The old standard apple box is still used in shipments of apples to Australia, and is one inch deeper than the dimensions here given.

CHERRY.—The cherry box is fifteen and one-half inches in length; ends, eight and one-quarter by three and one-half.

FIG.—The two-layer fig box is twenty inches long; ends, twelve by three and one-half inches, and holds about twenty pounds. The single-layer fig box is the same length and width, but two inches deep and holds about twelve pounds.

GRAPES.—The grape box is substantially the same as that used for plums in distant shipment, as described above, except that the depth is usually five inches and the contents about twenty-five pounds of fruit. Grapes are also shipped in four-pound splint baskets, of which four go in a half crate, or eight in a whole crate.

MELONS.—Cantaloupes are usually marketed in crates thirty-eight inches long, sixteen wide, and fifteen deep. Watermelons come in bulk in cars or in large cases of all descriptions.

ORANGES.—The flat orange box is twenty-two inches long; ends, seven and three-quarters by seventeen and one-half inches. It is divided in two parts by a central partition. The prevailing orange box at present is about twenty-six and one-half inches long; ends, eleven and one-half inches square, with a central partition.

SMALL FRUITS.—Berries and currants are marketed in chests or crates which contain ten, fifteen, or twenty drawers.

The drawers are fifteen and one-half inches long; ends, eight and one-quarter by one and three-quarters inches. The sizes of drawers, and, consequently, of the crates containing them, have been constantly decreasing. The old drawer held five pounds of strawberries; the present weight is about four pounds.

PACKAGES FOR DRIED FRUITS.

There is more confusion in sizes of dried fruit boxes than with fresh fruits, though the weights of twenty-five and fifty pounds is observed with substantial unanimity. One set of dimensions for a twenty-five-pound box is given on page 541; other commended sizes are as follows:—

TWENTY-FIVE-POUND BOX.—Inside measurements—length, thirteen and three-fourths inches; width, nine and three-fourths inches; depths, five and three-fourths inches. Outside measurements—length, fifteen and one-fourth inches; width, ten and one-half inches; depth, six and one-half inches. Top, bottom, and sides, three-eighths of an inch thick; ends, three-fourths of an inch thick. The above makes a thick box, while the dimensions below make a more flat package. Inside measurements—length, sixteen inches; width, nine inches; depth, five inches. Outside measurements—length, seventeen and one-fourth inches; width, nine and three-fourths inches; depth, five and three-fourths inches. Top, bottom, and sides, three-eighths of an inch thick; ends, five-eighths of an inch thick.

FIFTY-POUND BOX.—Inside measurements—length, fifteen and one-fourth inches; width, nine inches; depth, nine inches. Outside measurements—length, seventeen and one-fourth inches; width, ten inches; depth, ten inches. Top, bottom, and sides, one-half of an inch thick; ends, one inch thick.

An attempt at uniformity of width and depth was made by one large packer, who used a box nineteen and one-quarter inches long; ends, ten and one-half by nine and three-eighths, to hold fifty pounds; and the same length and width with a depth of four and three-quarter inches for a twenty-five-pound box. He also used a ten-pound box, nine and one-half inches long, with ends eight and three-quarters by five and one-half inches.

A twenty-five-pound prune box, which is used to some extent, is twelve and one-half inches long; ends, eight inches square.

RAISIN BOXES.—In raisin boxes there is substantial uniformity of size, and contents are commendably full weight; twenty-pound raisin box, nineteen and seven-eighths inches long; ends, nine by four and three-quarter inches; half box, same length and width; depth, two and three-eighths inches; quarter box, same length and width; depth, one and one-quarter inches; eighth box, fifteen and one-half inches long; ends, six by one and one-quarter inches.

SACKS FOR DRIED FRUIT.—White cotton sacks, made of what is called heavy export goods, are used for shipment of dried fruits. They are twenty by thirty-six inches and hold about eighty pounds of fruit.

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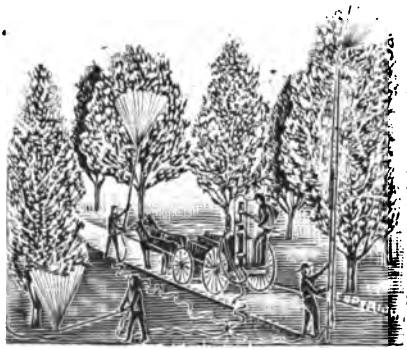

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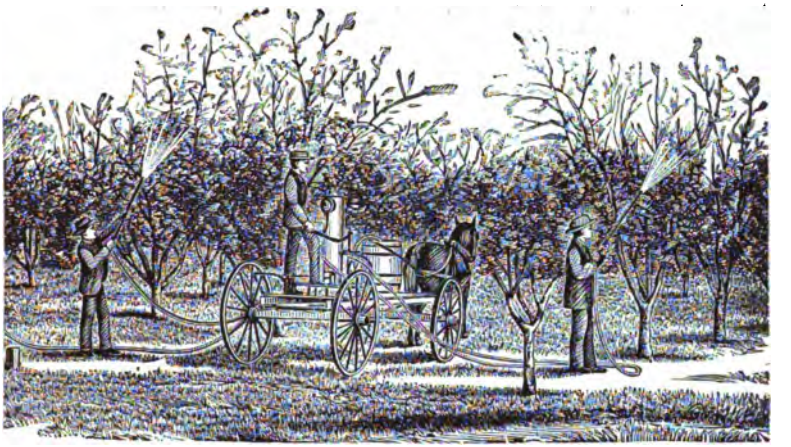


For Reliability, Durability, Simplicity and Ease of Operation the

"BEAN SPRAY PUMP"

has no equal. It throws a *strong, continuous, penetrating* spray. The receptacles are made of galvanized steel and when in operation are charged with air compressed with the fluid to be used as spray, thus enabling the men who are directing the sprays to continue their work while the man at the pump is attending his team, stiring the fluid in tank or taking a short rest. This is a great saving of valuable time. The cylinder of our pump cannot be hurt by any corrosive wash, and the valves are more lasting than any metal valve. With the use of a common farm wrench a man can get at the valves in a moment. Spraying at the best is expensive and a pump that will do the *most work* in the *shortest time* and do it *the best* is what is wanted. Thousands of fruit growers on the Pacific Coast and in States further east will and do testify that the

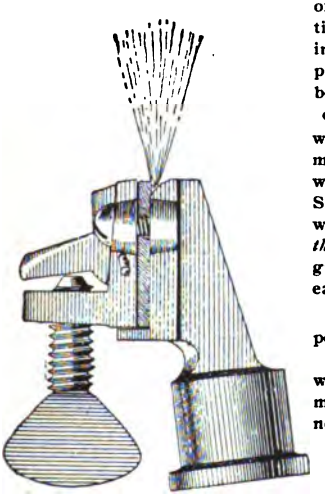
THE BEAN NOZZLE,
Price $1.00.

BEAN SPRAY PUMP

possesses these advantages.

THE BEAN SPRAY NOZZLES are well and widely known. They are less liable to clog and more easily cleaned when clogged than any other nozzle in the market.

For price and descriptive list write to.



THE NEW BEAN NOZZLE,
Price $1.00.

BEAN SPRAY PUMP CO.,
LOS GATOS, CAL.

LITTLE'S ANTIPEST

The Greatest Discovery of the 19th Century.

Silver Medal Awarded by the State Fair of 1890.

This invaluable preparation is a sure destroyer of the scale, wooly aphis and insect pests of any and all descriptions. It may be as freely used in the conservatory, garden and green house as in the orchard or vineyard. It is non-poisonous and harmless to vegetation when diluted and used according to directions. It mixes instantly with cold water in all proportions. It is safe, sure and cheap. No fruit grower or florist should be without it. Send for circulars and price list.

THE FOLLOWING TESTIMONIALS

Are sufficient Proof of the genuineness and efficacy of this Valuable Preparation.

UNIVERSITY OF CALIFORNIA,
AGRICULTURAL EXPERIMENT STATION,
BERKELEY, August 22, 1889.

GENTLEMEN: In regard to the sample of Insecticide submitted by you for trial, I beg leave to state that the preparation has been used on the University grounds with the following results: First—Four ounces of the Insecticide were added to one gallon of water and applied to wooly aphis on apple trees, with a spray pump. The insects were killed wherever touched by the wash; the result shows plainly that the material is effective wherever contact with the body of the insect can be secured. Second—One-half ounce of the Insecticide was added to one gallon of water and application made by spray to the green fly on rose bushes; the insects were killed on all sprigs reached by the spray.

Very respectfully,
E. J. WICKSON,
Assistant Superintendent Agricultural Grounds.

TRUMBULL & BEEBE, NURSERYMEN AND SEEDMEN,
419 AND 421 SANSOME STREET,
SAN FRANCISCO, Oct. 2, 1889.

GENTLEMEN: After giving your Antipest a thorough trial as a summer wash for Plum Aphis and Red Spider, I must say that the results are very satisfactory indeed, the destruction of the pest being most effectual, with no injury to the foliage or growth of the tree whatever. I am convinced that the Antipest will prove a better and safer wash for summer use than any of the Caustic washes now in use by most orchardists. Yours truly, W. P. HAMMON.

DIXON, April 28, 1891.

Have used your spraying solution with good results. Had occasion to try it on trees that were infested with Mealy Worm, Slug and Red Spider; it removed them in the form of a corpse almost instantly after it was applied. A. B. HOLDRIDGE.

CATTON, BELL & CO., 406 California St., S. F., Cal.

Sole Agents for the Pacific Coast.

STAR SPRAY PUMPS.

With two hose and all bamboo extensions, barrel and nozzles, complete in operation. The annexed cut represents our double-acting Star Spray Pump arranged for one or two sprays or hose. This pump is especially adapted for spraying liquids or poisons of any kind upon trees, shrubbery, orange trees, vines, etc., affected by bugs, worms, insects, etc. The valves are constructed entirely of brass, and even the packing is made of asbestos, which resists acids or hot mixtures of all kinds, and is capable of doing infinitely more service than any other pumps in the market, as it is of greater capacity, and, being double-acting in principle, throws a continuous and powerful stream. The need and usefulness of a pump of this kind as an aid to the orchardist and fruit-grower is so well-known as to hardly need any encomiums from us, although we could append hundreds of letters from private parties, as well as prominent members of State Agricultural Societies, which show this to be the only reliable and effective manner of treating these pests. We make these pumps so they will fit on the head of an ordinary barrel, capable of holding from 30 to 50 gallons of the liquid to be used, according to the purpose intended. We have a special Catalogue of Spray Pumps. Kindly send for it; mailed free upon application. WOODIN & LITTLE, 509 and 511 Market St., San Francisco, Cal. Manufacturers of all kinds of Cistern, Well, and Force Pumps. Adapted for every kind of requirement for both hand and power use. Railroad Pumps, Steamboat Pumps, Mining Pumps, Windmill Pumps, Rotary Pumps, Fire Engines, Hydraulic Rams, Hose, Garden Tools, and Pump Materials. Wine and Spray Pumps a Specality.

SEND FOR OUR CATALOGUE.

STAR SPRAY PUMP.

STAR PUMP.

IXL COMPOUND CO.

Manufacturers of the

Most Effective Tree and Vine Wash,

ROOM 5, 218 CALIFORNIA ST., SAN FRANCISCO.

The simplest and most efficient tree wash ever introduced.

BEST WORK. LEAST EXPENSE.

A certain insecticide. Stimulates and fertilizes trees, vines and shrubs. Send for circular containing testimonials.

P. & B. Fruit Papers

(PATENTED.)

ESPECIALLY ADAPTED FOR FRUIT DRYING.

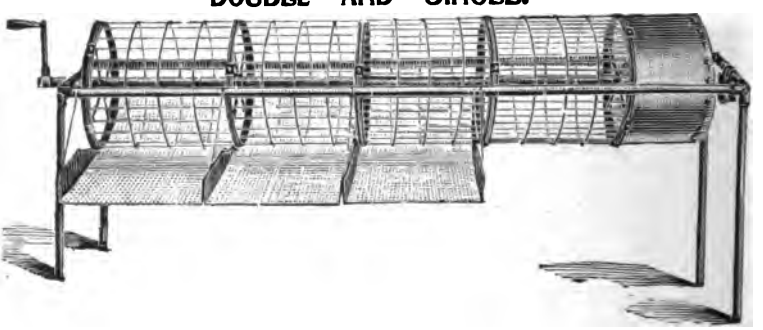
No need of expensive wooden trays. No need of turning fruit. Costs much less than any other method. *Samples and circulars free.*

PARAFFINE PAINT COMPANY,

116 BATTERY STREET, SAN FRANCISCO.

Wass Cylinder Fruit Grader,

DOUBLE AND SINGLE.



The most Rapid Working Machine that has ever been introduced. Its capacity is practically unlimited, as it will grade the fruit as fast as it can be fed into the machine.

WIRE WORK OF ALL KINDS.

Window Guards, Wrought Iron Fencing, Bank, Store and Office Railing, Store and Window Fixtures, Ornamental Wire Work, Roof Cresting and Finials, Sieves, Riddles and Screens, Galvanized Dipping Baskets, Prune Screens, and Cylinder Screens for removing fuzz and bloom.
Send for circulars, etc.

D. D. WASS, 141-143 FIRST STREET, SAN FRANCISCO, CAL.

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OF CALIFORNIA,

SAN FRANCISCO, CALIFORNIA.

Incorporated April, 1874.

Authorized Capital $1,000,000
Capital Paid-up & Reserve Fund 800,000
Dividends Paid to Stockholders 675,000

OFFICERS:

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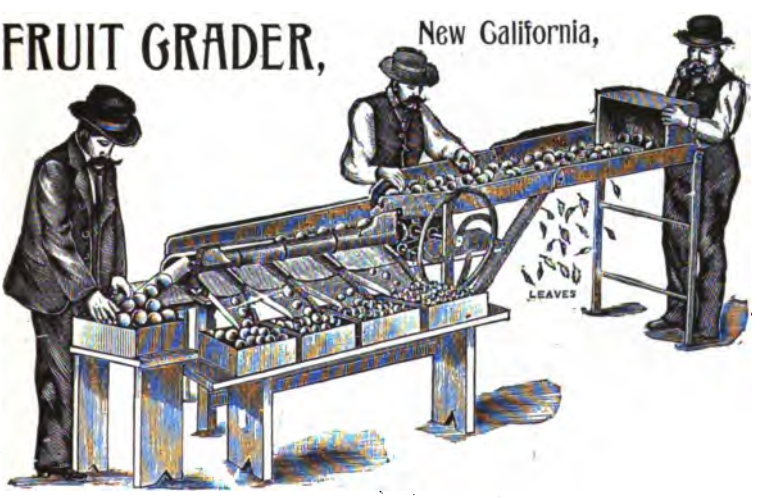
I. C. STEELE, - - - Vice-President.
ALBERT MONTPELLIER, Cashier and Manager.
FRANK McMULLEN - Secretary.

General Banking. Deposits received, Gold and Silver. Bills of Exchange bought and sold. Loans on wheat and country produce a specialty.

July 1, 1891. A. MONTPELLIER, Manager.

FRUIT GRADER, New California,



Grades all kinds of Fruits and Nuts, and the only Grader made that will grade grapes and cherries. Will not injure the most delicate; never clogs, as the fruit is carried on an endless rubber belt and does not depend upon gravity. For this reason its capacity for rapid work is double any other grader, while the price is less. All who use it commend it. Send for circular giving prices and testimonials. Manufacturers

ROSHER, CHANDLER & CO., 216 FRONT STREET, SAN FRANCISCO, CAL.

Cyclone Pumping AND Geared Windmills.

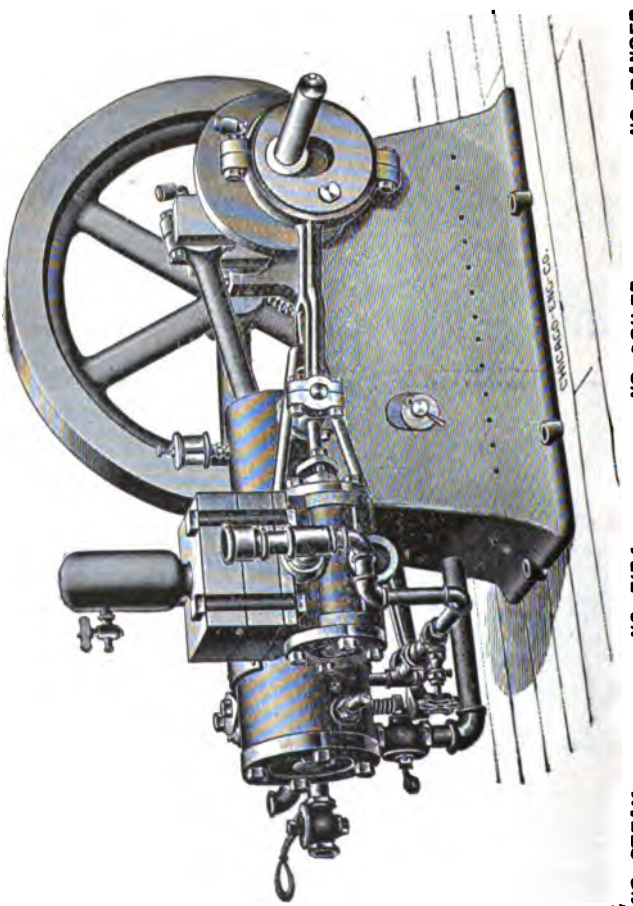
DIAMETER, 10 TO 30 FEET.

Tubular Well Boring Tools, Pumps, Tanks, Hose, Pipe, Fittings, Cylinders and Valves.

PACIFIC MANUFACTURING COMPANY,

575 MISSION STREET, SAN FRANCISCO, CAL.

REGAN VAPOR ENGINE.



NO STEAM • NO FIRE • NO BOILER • NO DANGER

Especially adapted for spraying fruit trees, irrigating and pumping wine in wine cellars. Portable plants mounted on trucks or wagon from ¾ to 4 H. P. Stationary and marine engines from ¾ to 15 H. P., from $175 up. Send for illustrated catalogue and price list.

REGAN VAPOR ENGINE COMPANY,

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MODERN · MACHINERY

FOR THE

Orchard, Farm and Dairy,

INCLUDING

PLOWS, CULTIVATORS, PULVERIZERS AND HARROWS.

For Deep and Thorough, also Surface Cultivation and Leveling.

THE DEERFIELD STEEL HARNESS.

A Great Safeguard Against Injury to Trees and Vines.

FRUIT GRADERS, DRIERS, BLEACHERS, CIDER MILLS AND PRESSES, THE CLARK PERFECTION KEROSENE OIL HEATING SYSTEM, FRUIT PARERS, CORERS, PITTERS AND CANNING APPARATUS, SPRAYING APPARATUS AND IRRIGATION OUTFITS.

Latest Improved Dairy Machinery.

CREAM SEPARATORS, CHURNS, BUTTER WORKERS, BUTTER AND CHEESE MAKING APPARATUS AND SUPPLIES.

HAY CUTTERS, FEED GRINDERS, HORSE POWERS, HARVESTING MACHINERY, AGRICULTURAL IMPLEMENTS, SAFE AND ECONOMICAL STEAM ENGINES AND BOILERS, BURNING WOOD, COAL OR OIL AS FUEL.

A VERY LARGE ASSORTMENT OF THE MOST IMPORTANT MECHANICAL IMPROVEMENTS OF THE AGE.

SEND FOR ILLUSTRATED AND DESCRIPTIVE CATALOGUE.

G. G. WICKSON & CO.,

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ZIMMERMAN EVAPORATOR.

For the evaporation of all kinds of fruit and vegetables.

FIRE PROOF. *SIMPLE.* *DURABLE.*

Five sizes made. Over 24,000 sold.

Sorghum Mills, Steam Engines, Horsepowers, Wood Saw Machines, Farmers' Boilers, "Blymyer" Church, School and Fire Bells. Also Farm Bells. Send for illustrated catalogues.

JAMES LINFORTH, 37 Market St., San Francisco

PACIFIC RURAL PRESS

The Leading Agricultural Home Newspaper and Standard Authority on all Branches of California Agriculture.

ESTABLISHED 1871.

It is the chief medium for the dissemination of information concerning fruit growing in California.

It has the fullest and most accurate REPORTS OF HORTICULTURAL MEETINGS, and is the best record of the EXPERIENCE OF INDIVIDUAL FRUIT GROWERS in all parts of the State.

Its market reports are prepared with care and the greatest reliability possible for the benefit of the producer.

It is a farm and home journal of the highest class, pure in tone and well informed on all matters of industrial interest. It is handsomely printed and illustrated. It is a 20-page weekly, and is furnished, postpaid, at the rate of $2 40 per year in advance.

A Rare Chance to Learn About California.

Readers who wish to know more about the genial sunset land of the Pacific Slope, its rare products and wonderful resources and climate, will do well to send 25 cents for a map and five sample copies of the (illustrated) PACIFIC RURAL PRESS, the largest and best agricultural weekly in the West, and one of the freshest and most original home farm papers in the world. Single copies, 10 cents. Address

DEWEY & CO., Publishers,

No. 220 Market St., San Francisco, Cal., Aug. 1891.

[E. J. WICKSON, Associate Editor since 1875.]

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Should consult DEWEY & CO., American and Foreign Patent Solicitors, for obtaining Patents and Caveats. Established in 1860. Their long experience as journalists and large practice as Patent Attorneys enable them to offer Pacific Coast inventors far better service than they can obtain elsewhere.

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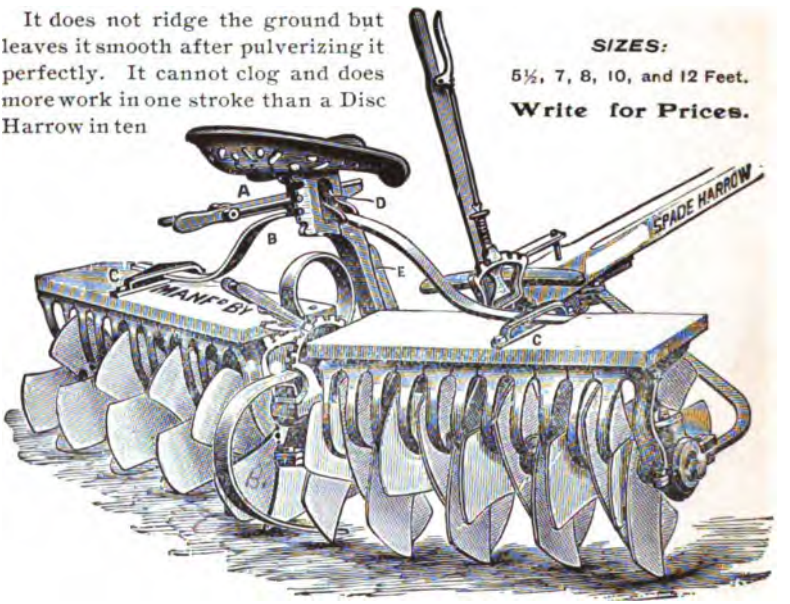
Catalogues on Application.

SOMETHING NEW.

It does not ridge the ground but leaves it smooth after pulverizing it perfectly. It cannot clog and does more work in one stroke than a Disc Harrow in ten

SIZES:
5½, 7, 8, 10, and 12 Feet.
Write for Prices.



PACIFIC SPADER AND VINEYARD CULTIVATOR

Patent combined Rotary Plow, tried and found the best implement of its class ever produced. Used by the largest Vineyardists and Orchardists in the State.

COURTLAND, Cal., Feb. 16, 1891.

MESSRS. TRUMAN, HOOKER & CO., San Francisco, Cal.

Dear Sirs: Your letter of the 6th inst. received and contents noted. Speaking of your Pacific Spader, my idea of it is, it does as good work as any I have seen so far.

Yours respectfully, (Signed) H. W. MYERS.

BORDEN FARM, MADERA, Fresno Co. Cal., Feb. 28, 1891.

MESSRS. TRUMAN, HOOKER & CO., San Francisco, Cal.

Gentlemen: In answer to your recent favor, will say I am using the Pacific Spader (bought at your Fresno house) on some newly plowed alfalfa land, and cannot speak too highly in its praise. This land was turned up in heavy sods, but the Spader reduced them in a way that gives me entire satisfaction. I expect to call upon you next week.

Very truly yours, W. H. WERFIELD.

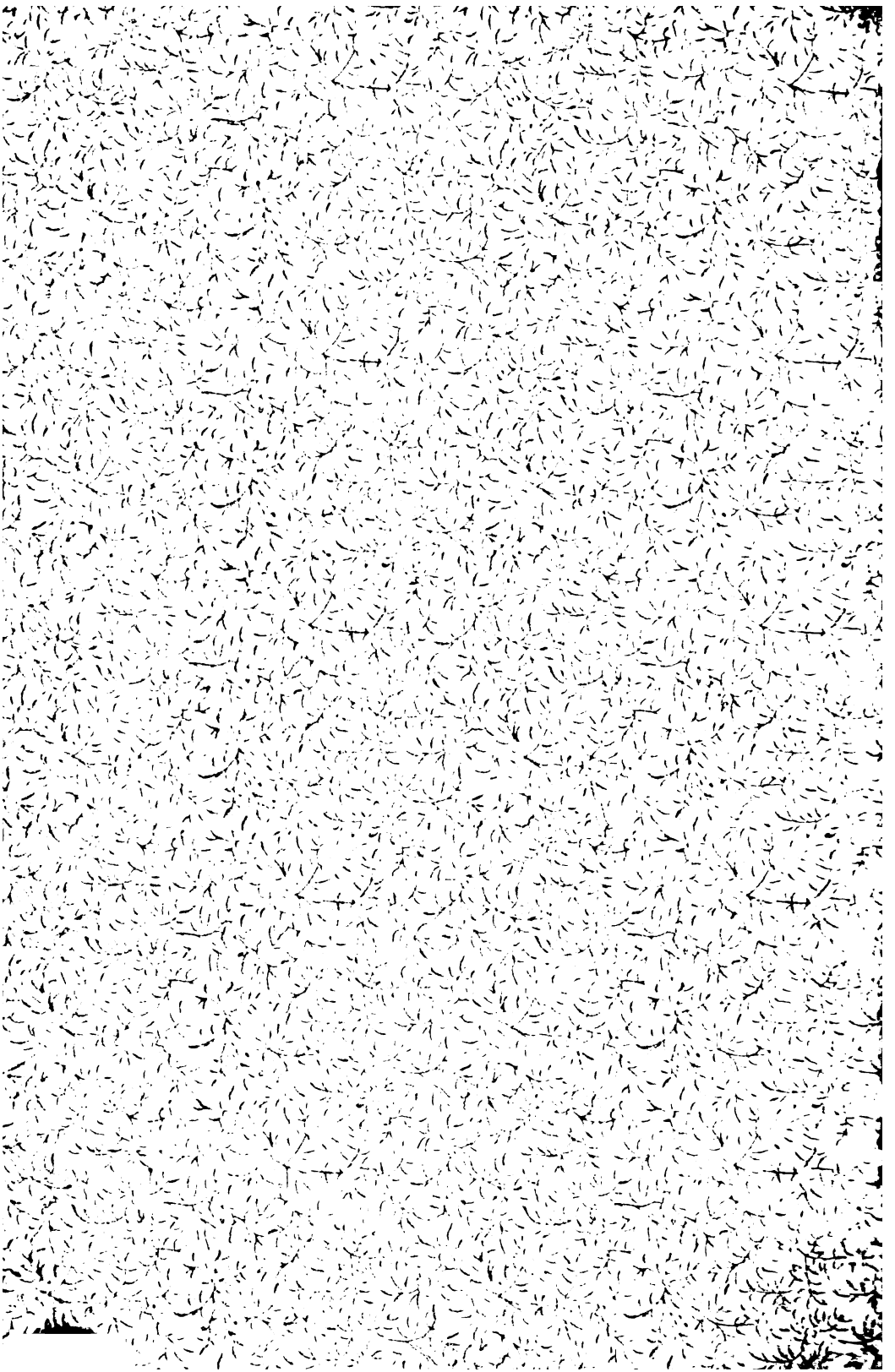
CHICO, March 18th, 1891.

MESSRS. TRUMAN, HOOKER & CO., San Francisco, Cal.

Gentlemen: I am in receipt of your favor of the 10th inst., and in reply desire to say, that so far as tried the Pacific Spader recently shipped me has proved eminently satisfactory. I am quite sure it is going to make a very useful implement.

Very truly yours, JOHN BIDWELL.

Headquarters for all kinds of Vineyard and Orchard Tools, Agricultural Implements and Vehicles of every description. Send for Catalogue.

Truman, Hooker & Co., San Francisco and Fresno.

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